Is use of electronic cigarettes while smoking associated with smoking cessation attempts, cessation and reduced cigarette consumption? A survey with a 1-year follow-up.

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Running head: E-cigarettes, cessation, attempts, reduction

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Abstract

Aims: Using a unique longitudinal dataset to assess the association between e-cigarette use while smoking with smoking cessation attempts, cessation and substantial reduction, taking into account frequency of use and key potential confounders.

Design: Web-based survey, baseline November/December 2012, 1-year follow-up December 2013.

Setting: Great Britain.

Participants: National general population sample of 4064 adult smokers, 1759 (43%) followed up.

Measurements: Main outcome measures were cessation attempt, cessation, and substantial reduction (≥50% from baseline to follow-up) of cigarettes per day (CPD). In logistic regression models, cessation attempt in the last year (analysis n=1473) and smoking status (n=1656) at follow-up were regressed on to baseline e-cigarette use (none, non-daily, daily) while adjusting for baseline socio-demographics, dependence and nicotine replacement (NRT) use. Substantial reduction (n=1042) was regressed on to follow-up e-cigarette use while adjusting for baseline socio-demographics and dependence and follow-up NRT use.

Findings: Compared with non-use, daily e-cigarette use at baseline was associated with increased cessation attempts (OR=2.11, 95% CI: 1.24 to 3.58, p=0.006), but not with cessation at follow-up (OR=0.62, 95% CI: 0.28 to 1.37, p=0.24). Non-daily use was not associated with cessation attempts or cessation. Daily e-cigarette use at follow-up was associated with increased odds of substantial reduction (OR=2.49, 95% CI: 1.14 to 5.45, p=0.02), non-daily use was not.

Conclusions: Daily use of e-cigarettes while smoking appears to be associated with subsequent increases in rates of attempting to stop smoking and reducing smoking but not with smoking cessation. Non-daily use of e-cigarettes while smoking does not appear to be associated with cessation attempts, cessation or reduced smoking.

Key words: electronic cigarettes, electronic nicotine delivery systems, smoking cessation, harm reduction, tobacco, quit attempts

Background

In electronic cigarettes, a battery-powered heating element heats a solution, usually containing nicotine, to produce an aerosol. The use of e-cigarettes has increased dramatically in the last few years; users are almost exclusively smokers or former smokers, with less than 1% of never-smokers using them regularly (1-8). The vast majority of e-cigarette users report using them to stop smoking tobacco (6, 9) and for example in England, smokers attempting to stop smoking now use e-cigarettes more often than any other aid, including nicotine replacement therapy (NRT)(10). Smoking prevalence in England has been declining from 20% in 2012 to 18.4% in 2014 (up to October), and in 2014, smoking cessation rates were the highest since at least 2008 (10, 11). This simultaneous increase in e-cigarette use and cessation may be coincidental and it is therefore vitally important for longitudinal studies to be conducted to assess the impact of e-cigarette usage on quitting behaviour.

Evidence on NRT supports the possibility of a link between using e-cigarettes that deliver nicotine and attempts to stop smoking. Use of NRT while smoking is associated with a small reduction in cigarette consumption and a significant increase in the likelihood of subsequent smoking cessation even in smokers without intentions to stop smoking (12, 13). Very little evidence is available to evaluate whether a similar pattern is observed with use of e-cigarettes by smokers and only a handful of studies have used any longitudinal data on e-cigarette use and smoking behaviour. A trial in smokers not intending to quit compared e-cigarettes with no nicotine with e-cigarettes with two different nicotine strengths and found that all led to significant reduction in tobacco consumption and that significantly more smokers using the e-cigarettes with nicotine quit smoking (14). In a web-based survey of a national sample of current smokers in the US who were followed up one year later, e-cigarette use at baseline did not predict smoking cessation one year later (15). Data from two waves of the International Tobacco Control survey showed that smokers who were using e-cigarettes at follow-up were more likely to have reduced their cigarette consumption than non-users, but cessation did not differ (9). Among a cohort of young adults in the US, those who had used e-cigarettes at least once in the month before baseline had a similar likelihood of quitting smoking one year later to those who had never used e-cigarettes (16). Unfortunately, none of

these analyses distinguished frequency of use and many defined any trial or experimentation, even if just once, as use, so it is unclear what proportion were actually using e-cigarettes with any regularity. Regular use is likely to have a stronger effect on smoking behaviour than trial or infrequent use. When separating regular from intermittent use, respondents who had used e-cigarettes daily for at least a month were far more likely to have quit smoking than those who had not used them whereas there was no such association of quitting with intermittent e-cigarette use (17). This highlights the importance of disentangling use from trial; however, intensity of e-cigarette use had to be determined retrospectively. Because use is more common in smokers making quit attempts and all those who had quit must have made a quit attempt, this method confounds e-cigarette use with quit attempts.

To address the question as to whether use of e-cigarettes by smokers is associated with smoking behaviour change, this study used a web-based national sample from the general population in Great Britain with a 1-year follow-up.

We used the two waves of survey data to assess the association of

1. daily, non-daily and non-use of e-cigarettes in smokers at baseline with smoking cessation attempts during follow-up (quit attempt analysis)

2. daily, non-daily and non-use of e-cigarettes in smokers at baseline with smoking cessation at follow-up (cessation analysis)

3. daily, non-daily and non-use of e-cigarette use at follow-up with substantial reduction in tobacco cigarette consumption from baseline to follow-up. First (primary reduction analysis), we excluded those using e-cigarettes at baseline because, if use of e-cigarettes is associated with reduction in tobacco consumption, respondents may already have reduced their consumption at baseline, making detection of reduction from baseline to follow-up less likely. As it could also be argued that e-cigarette using smokers should be reducing further, we then also included smokers using e-cigarettes at both time-points (secondary reduction analysis).

Methods

Design

A web-based longitudinal survey with baseline data collected in November/December 2012 and follow-up in December 2013. University College London ethics committee confirmed that specific approval was not required. Data were anonymised before being passed to the research team.

Sample

The study sample was recruited from an online panel managed by Ipsos MORI. Ipsos MORI is the second largest market research organisation in the United Kingdom. Members were invited by email to participate in an online study about smoking. By completing the survey respondents would earn points which could be redeemed against high street vouchers or used to enter a prize draw. Each respondent logged into their Ipsos MORI online account and was asked a screening question about their past year smoking status. Between November and December 2012, a total of 23,785 respondents were asked the screening question of whom 25.9% (n=6165) had smoked in the past year. This proportion was similar to that identified by a face-to-face survey of representative samples of the population in England during 2012 (10). Five-thousand respondents completed the survey (4064 current smokers). They were re-contacted one year later for follow-up. Follow-up achieved a response rate of 43.6% overall (n=2182) and of 43.3% among baseline smokers (n=1759). Figure 1 shows the selection of analyses samples for the three main outcomes.

The secondary reduction analysis included smokers using e-cigarettes at both time-points (n=1005).

Measures

Baseline and follow-up surveys included a range of questions on socio-demographic and smoking characteristics, nicotine use, quit attempts and health status. The current analyses included the following measures, fully presented in the Supporting information, Appendix.

Outcome measures

1. Quit attempts: Smokers and recent ex-smokers were asked about the number of attempts to stop they had made in the previous year. Those reporting at least one attempt and 37 respondents who did not report an attempt but had stopped smoking between baseline and follow-up were coded as having made an attempt.

2. Cessation: Smoking status was assessed at baseline and follow-up in all respondents. Change from being a smoker at baseline to being an ex-smoker at follow-up was coded as cessation.

3. Substantial reduction: Smoking characteristics included the number of cigarettes smoked per day (CPD) for daily smokers and the number of cigarettes per week for non-daily smokers. Number of cigarettes per week were divided by seven to calculate CPD. Substantial reduction was defined as a reduction by at least 50% from baseline CPD to follow-up CPD (13).

Socio-demographic characteristics, dependence and nicotine use

All characteristics were measured at baseline and follow-up; the analysis section explains which time points were used in each analysis. Respondents provided their age, gender and highest level of formal education (Appendix for questions and response options). Level of education was collapsed into those with any university education (including 'some university') and those without university education.

Strength of urges to smoke (SUTS) can be used as measure of dependence and is a strong predictor of successful cessation in population samples (18, 19). The SUTS was included rather than the Fagerstrom Test of Nicotine Dependence (FTND, (20)) or the subset of FTND questions used for the Heaviness of Smoking Index (HSI (21)) for two reasons. One reason was that the SUTS has outperformed the FTND in predicting failure of quit attempts (18); the second was that we hypothesized e-cigarette use to have an effect on smoking behaviour, specifically on the number of cigarettes smoked, one of the two components of the HSI, which would limit the comparability of scores across users and non-users of e-cigarettes.

Smokers and recent ex-smokers also reported if they were using NRT for any reason (not necessarily for a quit attempt), and how frequently they used NRT products. Respondents who had heard of e-cigarettes were asked whether they had ever tried one and if they had, how often they were currently using an e-

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cigarette. For the main analyses, frequency of use of NRT and e-cigarettes were each collapsed into daily, non-daily and none.

Analysis

Respondents who completed the follow-up were compared with those who did not respond to the invitation in terms of socio-demographic characteristics, nicotine use and dependence using t-tests or ANOVAS for continuous data and χ2 statistics for categorical data.

In the main logistic regression models, reports of at least one quit attempt in the last year and smoking status at follow-up were regressed on to baseline e-cigarette use (none, non-daily, daily) while adjusting for baseline age, gender, education, dependence (SUTS) and NRT use. Similar logistic regression models were used to analyse substantial reduction in CPD, but using NRT and e-cigarette use at follow-up, not baseline. Because only a small number of respondents overall had reduced substantially and 26.1% (n=322) of the sample for the primary reduction analysis had increased consumption, the quantitative change in CPD was analysed using multiple linear regression, adjusting for the same characteristics as in the logistic regressions but dummy-coding NRT and e-cigarette use.

As sensitivity analyses, we collapsed daily and non-daily e-cigarette use categories and conducted logistic regressions using the collapsed variable while adjusting as in the main models.

SPSS version 21 was used for all analyses.

Results

Prevalence and characteristics of users of e-cigarettes in the baseline survey have previously been reported (22). In brief, over 90% of current smokers and recent ex-smokers were aware of e-cigarettes, approximately a third had ever used e-cigarettes and a fifth was currently using them. Daily use was more common in recent ex-smokers (46% of current users) than in current smokers (23%). Age and gender split did not differ between users and non-users. Among smokers, e-cigarette users had a higher socio-economic

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status than non-users and were more likely to have made a quit attempt in the past year. Users reported higher tobacco cigarette consumption than non-users (22).

Follow-up respondents differed from respondents lost to follow-up on some baseline characteristics. Those lost to follow-up were younger and women were more likely to be lost to follow-up than men. Frequency of NRT use differed; those who used NRT less than daily were more likely lost to follow-up (Table A1). Education, dependence, and frequency of e-cigarette use did not differ.

A range of e-cigarettes were used and will be reported in a separate publication (23); briefly, a majority used 'first generation' e-cigarettes that were cigarette-like in appearance ('cigalikes').

Quit attempts

Overall, 46.2% (n=680) of respondents in the analysis made a quit attempt; 43.7% (n=508) of non-users of e-cigarettes, 52.5% (n=124) of non-daily e-cigarette users and 64.9% (n=48) of daily users. Sample characteristics are presented in Table 1. In unadjusted analysis, both daily (OR=2.38, 95% CI: 1.46 to 3.89, p=0.001) and non-daily e-cigarette use (OR=1.43, 95% CI: 1.08 to 1.89, p=0.013) were associated with increased likelihood of quit attempts compared with non-use.

While adjusting for socio-demographic characteristics, dependence and NRT use, daily e-cigarette use at baseline was associated with increased odds of making an attempt to stop smoking compared with non-use. Non-daily e-cigarette users did not significantly differ from non-users (Table 1). There was a strong association of quit attempts with daily and non-daily NRT use. In the sensitivity analysis that collapsed daily and non-daily use, e-cigarette use remained associated with quit attempts (OR=1.35, 95% CI: 1.03 to 1.77, p=0.03).

Smoking cessation

Among smokers not using e-cigarettes at baseline, 168 (12.9%) quit smoking, compared with 25 non-daily users (9.5%) and 7 daily users (8.1%). Sample characteristics are presented in Table 1. Unadjusted results showed no significant association with cessation for daily (OR=0.60, 95% CI: 0.27 to 1.32, p=0.21) or non-daily e-cigarette use (OR=0.71, 95% CI: 0.46 to 1.11, p=0.13) compared with non-use.

While adjusting for baseline characteristics, neither daily nor non-daily use of e-cigarette at baseline was associated with cessation at follow-up and neither was NRT use (Table 1). Considering any e-cigarette use (daily and non-daily), we found non-significantly reduced cessation (adjusted OR=0.73, 95% CI: 0.48 to 1.09, p=0.13).

Reduction in tobacco cigarette consumption

Overall, 6.2% (n=65) of respondents reduced their consumption substantially. Forty-four (5.7%) smokers not using e-cigarettes at follow-up, 11 (5.5%) non-daily e-cigarette users and 10 (13.9%) daily users reduced substantially. Sample characteristics are included in Table 2. In unadjusted analysis of substantial reduction, daily use of e-cigarettes at follow-up compared with non-use was associated with increased likelihood of reduction (OR=2.66, 95% CI: 1.28 to 5.54, p=0.009); non-daily use was not associated with substantial reduction (OR=0.96, 95% CI: 0.48 to 1.89, p=0.90).

In the primary reduction analysis and while adjusting for other relevant characteristics, daily use of e-cigarettes remained associated with increased likelihood of reduction while non-daily use was not significantly associated with substantial reduction (Table 2). Neither daily nor non-daily NRT use was associated with substantial reduction (Table 2).

When daily and non-daily e-cigarette use were collapsed, this was not significantly different from non-use (OR=1.23, 95% CI: 0.70 to 2.15, p=0.48). Secondary analysis in those using e-cigarettes at both time-points, adjusted for the same variables as the primary analysis, showed that compared with non-use at follow-up (n=769), daily e-cigarette use (n=79) was again associated with substantial reduction (OR=4.19, 95% CI: 2.13 to 8.24, p<0.001) while non-daily use (n=157) was not (OR=1.02, 95% CI: 0.48 to 2.19, p=0.96).

Linear regression on quantitative change in CPD indicated that the difference in change between those using e-cigarettes daily and those not using them at follow-up (Table 3) was significant while adjusting for baseline age, gender, education, dependence and follow-up NRT use [B(SE)=-1.55 (0.65), β=-0.08, p=0.02]. The difference in change between non-daily users and non-users was not significant [B (SE)=0.28 (0.41), β=0.02, p=0.50] Secondary analysis in those using e-cigarettes at both time-points suggested a larger difference between changes for daily users and non-users (Table 3, B (SE)=-2.58 (0.61), β=-0.14, p<0.001,

adjusted as before) whereas the difference in change between non-daily users and non-users remained small (B (SE)=-0.08 (0.44), β=-0.01, p=0.85).

Discussion

In a web-based national sample of smokers from the general population, those using e-cigarettes daily at baseline were more likely to have attempted to stop smoking when followed up a year later than smokers not using e-cigarettes but neither non-daily nor daily e-cigarette use was associated with smoking cessation during follow-up. Smokers using e-cigarettes daily when followed up were more likely to have achieved at least 50% reduction in tobacco cigarette consumption from baseline. Less frequent e-cigarette use did not have a significant effect on consumption. Using e-cigarettes every day while smoking increased the prevalence of substantial reduction in tobacco consumption and this was not restricted to smokers who had recently taken up e-cigarettes, suggesting persistent users continue to reduce consumption over time. Reduction in consumption has been reported previously (14). This increase in substantial reduction was reflected in a small overall reduction in the number of cigarettes smoked in daily e-cigarette users. The size of the reduction was similar to that seen in smokers using NRT (12). NRT itself showed a similar size of positive association with subsequent cessation to that found in previous studies (12) but in this case it was not statistically significant using a conventional alpha (p=.067 2-tailed).

The use of NRT while smoking is supported as a harm reduction approach by national guidance in the UK (24). It reduces tobacco harm not only by increasing cessation and reducing consumption but also by reducing the amount of nicotine taken in from each cigarette (25), which is likely to be accompanied by a reduction in intake of toxins (26, 27). Although it remains to be tested, it appears possible that the use of e-cigarettes while smoking similarly reduces intake from each cigarette, thus supporting tobacco harm reduction. Although long-term data on safety of e-cigarettes are not yet available, toxicology testing suggests they will be considerably safer than tobacco cigarettes (28) although they may be less safe than NRT which is licensed as medicine.

Smoking cessation rates in England were higher in 2014 than previous years. Generally, cessation rates in a population can be increased by encouraging as many smokers as possible to make quit attempts and to use

the most effective support in each of these attempts. The current data indicate that e-cigarettes were associated with more smokers attempting to stop smoking. We found no evidence that e-cigarette use while smoking increased subsequent smoking cessation. This is in line with previous findings (15, 16), although intense long-term use was associated with increased cessation in one recent study (17). The present analyses extend the evidence by assessing use prospectively, thus avoiding confounding with quit attempts (otherwise e-cigarette use may mainly be a marker of having made a quit attempt) and by assessing quit attempts, cessation and reduction separately. Further research on the link between smoking cessation rates and e-cigarette use is warranted.

Importantly, the current sample used e-cigarettes for any reason, not necessarily to stop smoking, so the results cannot be used to derive statements on their effectiveness as cessation aids. Few studies have looked at e-cigarettes as cessation aids. One randomised controlled trial indicated that the particular e-cigarette used in the trial was of similar effectiveness as nicotine patches in supporting abstinence (29). Use and effects of different devices in the general population are likely to differ from those in controlled trials and samples of dedicated e-cigarette users may differ from other users in the general population. A recent study using a representative population sample found that smokers who used e-cigarettes in an attempt to stop smoking were more likely to report continued abstinence than those using NRT without prescription or no aids (30). Further high-quality longitudinal studies are needed on e-cigarettes as cessation aids. Future research should also evaluate the impact of continued use of e-cigarettes on smoking behaviour as we were only able to provide snapshots of use at two time-points.

Further evidence is needed on differences between the numerous types of e-cigarettes, as products vary widely in their appearance, function, content, marketing and nicotine delivery (31-34) and use and effects on smoking will vary considerably across different types. In this sample, the majority were using cigarette-like products. These have been found to deliver less nicotine than more recently developed products (22, 32, 35) and in a sample of ex-smokers who had quit using e-cigarettes, all had used more recently developed products (36), indicating that cigarette-like e-cigarettes may be less helpful.

Several limitations of the study should be noted. Follow-up rate was 43%, resulting in small sample sizes for some analysis. Respondents who were followed up differed from those not followed up on some demographic variables, specifically age and gender, potentially reducing the generalizability to younger and female smokers. However, key smoking characteristics and e-cigarette use were not associated with follow-up. The survey did not include questions on the duration of use so non-daily e-cigarette users will have included people who had just tried e-cigarettes once or twice as well as occasional users. This also means that we did not assess if respondents continued to use e-cigarettes throughout the follow-up period and not all baseline users may have continued to use them. Also, those initiating e-cigarette use during the follow-up period were included with baseline non-users. Any short-term use of e-cigarettes around baseline and uptake during follow-up will therefore have led to an underestimation of their effects on quit attempts and cessation. Additionally, the baseline sample including only smokers would have excluded any ex-smokers who had used e-cigarettes and successfully quit, thus potentially biasing the sample in favour of 'treatment failures'. The definition of cessation did not include a minimum time of abstinence but relied on respondents' self-report. However, this method avoids recall bias, and in population surveys, risk of misreporting is reduced as there is no expectation to report cessation (37). The online recruitment method is likely to have led to some selection bias as internet use is linked to socio-economic status and age; however, the socio-economic divide has narrowed considerably between 2011 and 2013 (38). The sample was self-selected insofar as participants had volunteered for a market research company web panel, nevertheless the overall sample characteristics were broadly similar to those of representative samples from a national household survey (22, 39).

The recruitment method also represents a strength, as in contrast to many early studies of e-cigarettes that recruited from e-cigarette interest groups e.g. (33, 40), recruitment was not from self-selected populations with decidedly positive attitudes towards the devices. Thus, the association between their use and changes in smoking behaviour found in this study is expected to be more widely generalizable. The present survey has overcome another limitation of the very small number of previous longitudinal studies by separating regular and occasional use. More frequent use showed an effect on smoking behaviour where occasional use did not and the effect of e-cigarettes on reduction in tobacco consumption disappeared when not

differentiating frequency of use, suggesting that previous analyses may have overlooked effects. The current study may have missed important factors associated with quit attempts, cessation or reduction, for example use of other aids to stop smoking or mental health status of respondents. However, by adjusting for a range of important characteristics such as age, gender and dependence, it takes into account more potential confounders than previous longitudinal studies (15, 40).

Conclusions

Daily use of e-cigarette use while smoking at one time-point is associated with subsequent increases in rates of attempting to quit smoking and reducing smoking but not with increased smoking cessation. These effects persisted after adjusting for a range of socio-demographic characteristics, dependence and other nicotine use. Non-daily use of e-cigarettes while smoking is not associated with quit attempts, cessation or reduced smoking. These findings illustrate the importance of differentiating ever use or very occasional use from regular use in assessing the effects of e-cigarette use on smoking behaviour, a differentiation that has frequently been overlooked in previous research.

Acknowledgements

Table 1: Logistic regression analyses of association of baseline socio-demographics, dependence (SUTS) and non-cigarette nicotine intake with quit attempts and smoking cessation during follow-up.

		Quit attempt (n=1473, of whom n=680 made attempt)				Cessation (n=1656, of whom n=200 stopped smoking)			
		N(%)/M(SD)	OR	95% CI	p	N(%)/M(SD)	OR	95% CI	p
Age [1]		46.6 (15.2)	0.83	0.77 to 0.90	<0.001	45.7 (15.3)	0.88	0.79 to 0.97	0.009
Gender	Female	642 (43.6)	1			720 (43.5)	1		
	Male	831 (56.4)	0.84	0.67 to 1.05	0.12	936 (56.5)	0.86	0.64 to 1.16	0.32
Level of education	No HE	958 (65.0)	1			1074 (64.9)	1		
	Some HE	515 (35.0)	0.83	0.66 to 1.05	0.12	582 (35.1)	0.76	0.55 to 1.05	0.099
SUTS [2]		2.2 (1.1)	1.06	0.96 to 1.18	0.25	2.2 (1.1)	0.74	0.64 to 0.86	<0.001
NRT use	None	1212 (82.3)	1			1339 (80.9)	1		
	Non-Daily	161 (10.9)	4.21	2.89 to 6.14	<0.001	193 (11.7)	1.39	0.88 to 2.21	0.16
	Daily	100 (6.8)	9.43	5.17 to 17.23	<0.001	124 (7.5)	1.67	0.98 to 2.84	0.062
E-cig use	None	1163 (79.0)	1			1307 (78.9)	1		
	Non-Daily	236 (16.0)	1.18	0.87 to 1.60	0.29	263 (15.9)	0.77	0.49 to 1.21	0.25
	Daily	74 (5.0)	2.11	1.24 to 3.58	0.006	86 (5.2)	0.62	0.28 to 1.37	0.24

[1] Mean and SD presented, OR for single year raised to the power of 10 to present per 10-year increase.

[2] Strengths of urges to smoke, possible range 0 'no urges' to 5 'extremely strong urges', mean and SD presented, OR per unit increase.

HE: Higher education

Table 2: Logistic regression analyses of association of socio-demographics, dependence (SUTS) and non-cigarette nicotine intake at follow-up with substantial reduction in cigarettes per day (CPD).

|		Reduction (n=1042, of whom n=65 reduced CPD by ≥50% of baseline)			
		N(%) / M(SD)	OR	95% CI	p
Baseline age [1]		46.7 (15.3)	0.99	0.78 to 1.08	0.30
Gender	Female	455 (43.7)	1		
	Male	587 (56.3)	0.51	0.30 to 0.86	0.012
Baseline level of	No HE	706 (67.8)	1		
education	Some HE	336 (32.3)	0.90	0.52 to 1.57	0.71
Baseline SUTS [2]		2.1 (1.1)	0.76	0.59 to 0.98	0.031
Follow-up NRT use	None	909 (87.2)	1		
	Non-daily	83 (8.0)	1.50	0.61 to 3.70	0.38
	Daily	50 (4.8)	1.66	0.58 to 4.70	0.34
Follow-up E-cig use	None	769 (73.8)	1		
	Non-daily	201 (19.3)	0.85	0.43 to 1.71	0.66
	Daily	72 (6.9)	2.49	1.14 to 5.45	0.022

[1] Mean and SD presented, OR for single year raised to the power of 10 to present per 10-year increase.

[2] Strengths of urges to smoke, possible range 0 'no urges' to 5 'extremely strong urges', mean and SD presented, OR per unit increase.

HE: Higher education

Table 3:Cigarettes per day by frequency of e-cigarette use.

	Mean (SD) cigarettes per day		
Follow-up e-cigarette use	**Baseline**	**Follow-up**	**Change**
None	13.3 (8.9)	13.5 (8.9)	0.2 (4.7)
Primary analysis, use initiated after baseline			
Non-daily	13.5 (7.9)	13.9 (8.9)	0.4 (5.9)
Daily	14.3 (9.8)	13.0 (9.4)	-1.4 (6.8)
Secondary analysis, some use at baseline			
Non-daily	14.9 (8.9)	15.0 (8.0)	0.09 (5.4)
Daily	14.1 (7.9)	11.5 (7.2)	-2.5 (6.1)
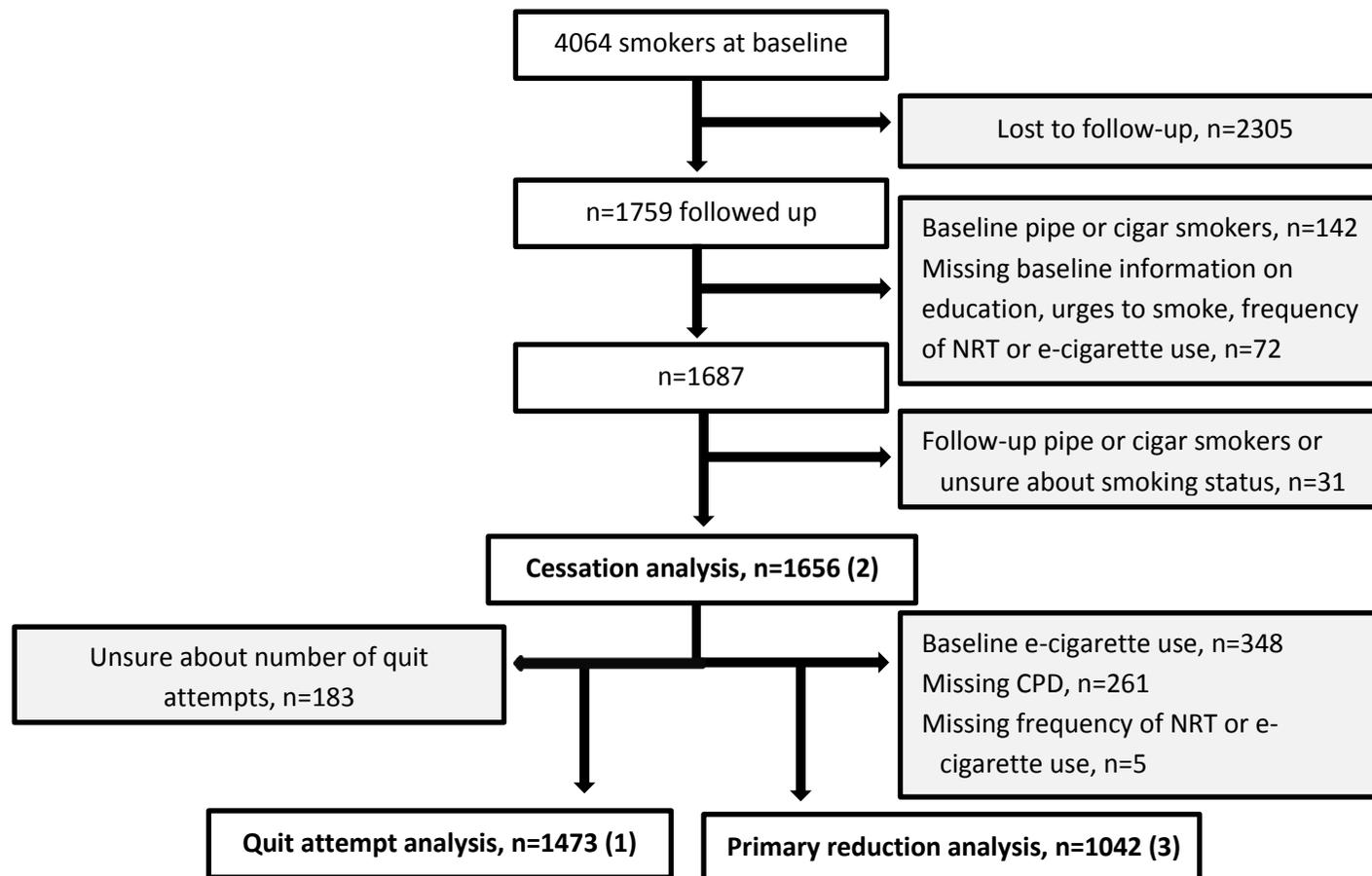
Figure 1: Sample flowchart. Grey boxes indicate exclusions. Bold numbers in brackets indicate the three different outcomes. CPD: cigarettes per day

Supporting information - Appendix

Measures

Highest level of education

What is the highest level of formal education that you have completed?

a) Primary or secondary school/vocational level 1 & 2/ trade apprenticeship

b) Secondary school advanced/vocational level 3

c) Further education/training college below degree level

d) Some university

e) Completed university degree

f) Post-graduate degree

g) Don't know

h) Prefer not to say

Smoking status

Which of the following best applies to you?

a) I smoke cigarettes (including hand-rolled) everyday

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

f) Don't know/ couldn't say .

[Those responding 'Yes' to either (a) or (b) were classified as current (daily and non-daily) smokers and those responding 'Yes' to (d) or (e) were classified as ex-smokers. Those responding (c) or (f) at either wave were not included in these analyses.]

Quit attempts

How many serious attempts to stop smoking have you made in the last 12 months? By serious attempt we mean you decided that you would try to make sure you never smoked again. Please include any attempt that you are currently making and please include any successful or unsuccessful attempt made within the last year.

- ….times
- Don't know/couldn't say

Tobacco cigarette consumption

How many cigarettes do/did you usually smoke? We are just looking for your best estimate.

- Please enter number per day if usually smoke/d every day
- Please enter number per week if you do/did not usually smoke every day

- Don't know / couldn't say

Strengths of urges to smoke

1) How much of the time have you felt the urge to smoke in the past 24 hours?

    a) Not at all

    b) A little of the time

    c) Some of the time

    d) A lot of the time

    e) Almost all of the time

    f) All of the time

2) In general, how strong have the urges to smoke been?

    a) Slight

    b) Moderate

    c) Strong

    d) Very strong

    e) Extremely strong

[Question 2 is asked of those choosing a response other than a) for question 1. Those who chose response a for question 1 were coded as 0 to create a final strength of urges scale ranging from 0 (no urges) to 5 (extremely strong urges).]

Nicotine replacement therapy use

Can I check, are you using any of the following either to help you stop smoking, to help you cut down or for any other reason at all? [Positive response to a, b, c , d, e or g coded as using NRT.]

    a) Nicotine gum

    b) Nicotine replacement lozenges\tablets

    c) Nicotine replacement inhaler\inhalator

    d) Nicotine replacement nasal spray

    e) Nicotine patch

    f) Electronic cigarette

    g) Nicotine mouthspray

    h) Another nicotine product

    i) Other (please write in)

    j) None of these / not using anything

    k) Don't know

How often on average do you use your nicotine replacement product or products? [Asked if any used]

    a) Every day

    b) Not every day, but at least once a week

c) Less often than once a week

d) Don't know / couldn't say

E-cigarette use

How often, if at all, do you currently use an electronic cigarette? [Asked of respondents who had ever heard of e-cigarettes and had ever tried one.]

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

Type of e-cigarette used

Three questions were used to determine type, responses to questions 2 and 3 were checked against information from producers and retailers of e-cigarettes to determine whether respondents were using cigalikes or other types (23).

1) What electronic cigarette equipment do you currently use the most?

a) A disposable electronic cigarette (non-rechargeable)

b) A commercial electronic cigarette kit which is refillable with pre-filled cartridges

c) A commercial electronic cigarette kit which is refillable with liquids

d) A modular system (I use my own combination of separate devices: batteries, atomizers, etc.)

e) Don't know

2) What is the name of the brand of e-cigarettes that you currently use the most?

Comprehensive list of brands and choice of 'other brand (please write in)'.

3) What is the name or type of e-cigarette product that you use in their range? Please try and be as specific as possible. For example, someone using E-Lites may indicate that they are using the 'E40' model in that range, with a 'Regular/Red' nicotine strength. This is the level of detail that we are ideally looking for.

Free-text responses

Table A1. Comparison of respondents followed up and lost to follow-up

Baseline characteristics		Followed up, n=2182	Lost to follow-up, n=2818	Comparison statistic
Age, M (SD)		46.4 (15.5)	40.8 (14.4)	t=13.3, p<0.001
Gender, % female		41.8	51.7	χ^2=48.8, p<0.001
Education, % no higher education		63.7	61.6	χ^2=2.3 , p=0.13
SUTS, M (SD)*		1.9 (1.2)	2.0 (1.2)	t=1.73, p=0.08
NRT use, %	None	82.0	77.6	χ^2=13.8 , p=0.001
	Non-daily	10.6	13.7	
	Daily	7.4	8.3	
	Missing (don't know)	0.2	0.4	
E-cigarette use, %	None	80.8	78.1	χ^2=5.4 , p=0.07
	Non-daily	14.0	15.9	
	Daily	5.1	5.9	
	Missing (don't know)	0.1	0.1	

* N=81 reported don't know in response to either of the questions from which the SUTS is derived. Of those, 51 (63%) were lost to follow-up

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