From: [redacted]
To:

Cc:

Date: Friday, July 06, 2018 11:50AM
Subject: Ecigs are a massive gateway to smoking for previous never user adolescents

History: ➪ This message has been forwarded.

Hong Kong, unlike Singapore does not have a tobacco retailer licensing scheme nor inspection system, nor display ban.

Hong Kong TCO is massively understaffed, even after the puny addition of 20 retired police officers.

The Ombudsman report requirements have not been fulfilled.

They have at best 50 officers per shift to operate in HKI, Kowloon, NT, Marine and Islands districts.

This bright-spark Govt then decided they will use the same tiny enforcement group to prevent underage alcohol sales.

The attached small sample of numerous available evidence on 'ever' Ecig use leading to a gateway of combustible use by adolescents should be self-explanatory

to any sensible Health Department.

It is indisputable.

Making legislation banning use of ENDs by adolescents here is manifestly unenforceable. The USA has such legislation and is in an admitted Ecig epidemic

with the FDA trying to play catch-up after the damage was already done. Thousands of US adolescents are addicted to JUUL. We found a local company imports

and sells what they call JUUL here also.

Ecigs have been shown in a ten year UK study to have ZERO effect on smoking cessation amongst 200,000 UK adults. Indeed Ecigs made them into dual users.

So to summarise, ENDs addict teens and lead to cigarette smoking, they addict youth and adults to nicotine and there is little evidence of success in smoking cessation amongst adults – even worse, many are double health whammy dual users.

The only sensible thing for any Government to do is to **BAN** the import, use and sales of these nefarious products until such time as each product achieves safety certification.

To date no ENDs product in the world has applied for, nor received such certification. They cannot pass emissions nor other testing. What level of aldehydes, DNA damage, COPD and heavy metals are deemed safe?

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Knowingly permitting these products to be used here legally will render the Government open to future class action lawsuits for deliberate negligence and lack of duty of care and will renormalize smoking.

What's next, will our Government allow us NOT to wear crash helmets on motorbikes, no more seat belts in vehicles, no safety helmets or safety harnesses on building sites?

We should send our Health Department hierarchy to Singapore for tobacco control training – they are way ahead of us and have Political Will. They have drafted FCTC requirements into local legislation, unlike here, where apathy reigns.

James Middleton

Chairman

http://cleartheair.org.hk

Attachments:

Ecig-massive-youth-Gateway-to-smoking.pdf

OPEN ACCESS

Do electronic cigarettes increase cigarette smoking in UK adolescents? Evidence from a 12-month prospective study

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ABSTRACT

Background In cross-sectional surveys, increasing numbers of adolescents report using both electronic cigarettes (e-cigarettes) and cigarettes. This study assessed whether adolescent e-cigarette use was associated prospectively with initiation or escalation of cigarette use.

Methods Data were from 2836 adolescents (aged 13–14 years at baseline) in 20 schools in England. At baseline, breath carbon monoxide levels, self-reported e-cigarette and cigarette use, sex, age, friends and family smoking, beliefs about cigarette use and percentage receiving free school meals (measure of socioeconomic status) were assessed. At 12-month follow-up, self-reported cigarette use was assessed and validated by breath carbon monoxide levels.

Results At baseline, 34.2% of adolescents reported ever using e-cigarettes (16.0% used only e-cigarettes). Baseline ever use of e-cigarettes was strongly associated with subsequent initiation (n=1726; OR 5.38, 95% CI 4.02 to 7.22; controlling for covariates, OR 4.06, 95% CI 2.94 to 5.60) and escalation (n=318; OR 1.91, 95% CI 1.14 to 3.21; controlling for covariates, this effect became non-significant, OR 1.39, 95% CI 0.97 to 1.82) of cigarette use.

Conclusions This is the first study to report prospective relationships between ever use of e-cigarettes and initiation and escalation of cigarette use among UK adolescents. Ever use of e-cigarettes was robustly associated with initiation but more modestly related to escalation of cigarette use. Further research with longer follow-up in a broader age range of adolescents is required.

INTRODUCTION

Electronic cigarettes (e-cigarettes) deliver inhaled aerosol usually containing nicotine. E-cigarettes are thought to have minimal impact on morbidity and mortality[1 2] and are recognised as harm reducing for adult smokers.[2–4] Although rates of adolescent regular use of e-cigarettes are low, rates of ever use are substantial (13%–22%) and have increased over recent years, whereas rates of cigarette use have decreased over the same period both in the USA[5–7] and UK.[8–15] Nevertheless, the possible relationship between adolescent e-cigarette use and the initiation and escalation of cigarette use remains under-researched.

Longitudinal data on e-cigarette use and subsequent cigarette use are currently limited to US samples based on unverified self-reported measures.[16–19] For example, two US studies reported baseline e-cigarette use to be positively associated with the initiation of cigarette use 12 months later in 14-year olds controlling for various predictors of smoking (OR 1.75, 95% CI 1.10 to 2.77; OR 2.87, 95% CI 2.03 to 4.05).[17 18] Barrington-Trimis *et al*[16] reported similar findings over 16 months in 17-year-olds (OR 6.17, 95% CI 3.30 to 11.6), whereas Wills *et al*[19] reported that e-cigarette use was linked to initiation (OR 2.87, 95% CI 2.03 to 4.05) but not to escalation of smoking over 12 months in a sample of adolescents aged 14–15 years.

This study is novel in assessing these relationships between e-cigarette use and subsequent cigarette use in a sample of UK adolescents and in exploring a number of previously unexamined smoking risk factors as covariates and moderators. In particular, we investigated the extent to which baseline ever use of e-cigarettes was associated with the initiation or escalation of cigarette use (objectively validated) 12 months later in a sample of UK adolescents aged 13–14 years. The impact of controlling for various smoking risk factors such as friends and family smoking and their moderating effects was also explored.

METHODS

Participants and procedures

Data were collected as part of a 4-year cluster randomised controlled trial of a school-based smoking initiation intervention[20 21] based on implementation intentions.[22] Data from 2836 adolescents (13–14 years at baseline) in the 20 control schools are reported here. Head teachers consented to school participation with parents given the option to withdraw children from the study. Adolescents consented by completing questionnaires matched across time points using a personally generated code. The data reported here are from waves 3 (September–December 2014; referred to as *baseline*) and 4 (September–December 2015; referred to as *follow-up*) of the trial when e-cigarette use measures were added to the data collection.

The Faculty of Medicine, University of Leeds, UK, ethical review committee approved the study (reference 12–0155).

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Table 1 Descriptive data for the full sample and subsamples

		Cross-sectional sample (total N=2836)		Longitudinal sample of baseline never used cigarettes (total n=1726)		Longitudinal sample of baseline once/ used to use cigarettes (total n=318)	
		N/M	(%/SD)	N/M	(%/SD)	N/M	(%/SD)
Age		13.18	(0.39)	13.18	(0.39)	13.17	(0.39)
Sex	Boy	1411	(49.8%)	898	(48.0%)	164	(51.6%)
	Girl	1425	(50.2%)	898	(52.0%)	154	(48.4%)
Heard of e-cigarettes (baseline)	No	346	(12.2%)	227	(13.2%)	24	(7.5%)
	Yes	2383	(84.2%)	1381	(80.0%)	286	(90.0%)
	Don't know	103	(3.2%)	118	(6.8%)	8	(2.5%)
Ever used e-cigarettes (baseline)	No	1867	(65.8%)	1383	(80.1%)	70	(22.0%)
	Yes	969	(34.2%)	343	(19.9%)	248	(78.0%)
Ever used cigarettes (baseline)	No	2196	(77.4%)	1726)	(100.0%	0	(0.0%)
	Yes	640	(22.6%)	0	(0.0%)	318	(100.0%)
Family smokers = none		898	(31.7%)	666	(38.6%)	42	(13.2%)
Family smokers = one		852	(30.0%)	534	(30.9%)	88	(27.7%)
Family smokers = two		517	(19.2%)	298	(17.3%)	74	(23.2%)
Family smokers = three or more		569	(20.1%)	228	(13.2%)	114	(35.8%)
Friend smokers = none		1384	(48.8%)	1050	(60.8%)	67	(21.1%)
Friend smokers = a few		1135	(40.0%)	613	(35.5%)	189	(59.4%)
Friend smokers = most		317	(11.2%)	63	(3.7%)	62	(19.5%)
Intentions		4.69	(0.77)	4.87	(0.50)	4.48	(0.76)
Attitude		4.73	(0.57)	4.88	(0.32)	4.51	(0.65)
Perceived norms		4.81	(0.57)	4.91	(0.30)	4.66	(0.50)
Perceived behavioural control		4.61	(0.72)	4.78	(0.49)	4.43	(0.71)
Self-efficacy		4.64	(0.77)	4.83	(0.47)	4.41	(0.82)
Free school meals*		14.24	(6.63)	13.82	(6.55)	15.57	(6.35)

*Mean and SD for this variable based on school-level data.

Measures

Cigarette use was assessed using a standardised measure[23] at both time points; adolescents ticked one of the following: 'I have never smoked; I have only tried smoking once; I used to smoke sometimes, but I never smoke cigarettes now; I sometimes smoke cigarettes now, but I don't smoke as many as one a week; I usually smoke between one and six cigarettes a week; and I usually smoke more than six cigarettes a week'. Self-reported smoking was validated against a measure of breath carbon monoxide (CO) levels (using Micro+ Smokerlyzer CO Monitor; Bedfont Scientific Limited, Kent, England, UK). Such measures are reliable and valid ways of assessing regular cigarette smoking[24 25] but not occasional smoking due to the short half-life (4–6 hours) of breath CO.

E-cigarettes/vapourisers were described as 'a tube that sometimes looks like a normal cigarette and has a glowing tip. They all puff a vapour that looks like smoke but unlike normal cigarettes, they don't burn tobacco'. Awareness ('Have you ever heard of e-cigarettes or vapourisers?' yes I have; no I haven't; I don't know) and use ('Which ONE of the following is closest to describing your experience of e-cigarettes or vapourisers?' I have never used them; I have tried them once or twice; I use them sometimes (more than once a month but less than once a week); I use them often (more than once a week)) of e-cigarettes were tapped by single items.

Other measures were assessed as covariates/moderators. Percentage of children at a school eligible for free school meals was used as an indicator of socioeconomic status.[26] Sex and age were measured (age not used in analyses as adolescents from one school year). Family smoking was assessed using the question, 'Who smokes in your family now? Tick all the people who smoke at the moment', followed by a list of family members (zero to nine family members marked; scored as 0, 1, 2 or 3 or more). Friends' smoking was assessed using the question, 'How many of your friends smoke?' none of them; only a few; half and half; most but not all; all of them (scored as none of them, a few or most (last three categories)).

Baseline health cognitions about smoking[21] were assessed as mean of multiple items on five-point scales (high scores indicated negative views of smoking): intention was tapped by three statements ('I plan not to smoke', 'I don't want to smoke' and 'I will try not to smoke'; strongly disagree to strongly agree; Cronbach's alpha 0.90), attitude by seven statements ('For me, smoking would be… good–bad; beneficial–harmful; pleasant–unpleasant; enjoyable–unenjoyable; wise–foolish; fun–not fun; healthy–unhealthy'; Cronbach's alpha 0.87), norms by five statements ('Most of my friends think…'; 'My best male friend thinks…'; 'My best female friend thinks…'; 'My family think…'; 'People who are important to me think…'; I should smoke–I should not smoke; Cronbach's alpha 0.79), perceived behavioural control by three statements ('I am confident I could resist smoking', strongly disagree to strongly agree; 'For me to not smoke would be…', difficult–easy; 'How much control do you feel you have over not smoking?' no control–complete control; Cronbach's alpha 0.69) and self-efficacy by six statements ('I can say no to smoking, even at school'; 'I can say no to smoking even when I am offered a cigarette'; 'I can say no to smoking, even if my friends want me to smoke'; 'I can say no to smoking, even if I was the only one in the group not smoking'; 'I can say no to smoking, even if I feel a bit left out of the group'; 'I can say no to smoking, even if I feel like smoking'; strongly disagree-strongly agree; Cronbach's alpha 0.91).

Table 2 Relationships between cigarette and e-cigarette use: (A) cross-sectional relationships between baseline cigarette and e-cigarette use; (B) prospective relationships between cigarette use at 1-year follow-up and e-cigarette use at baseline among baseline never used cigarettes; (C) prospective relationships between cigarette use at 1-year follow-up and e-cigarette use at baseline among baseline used once or used to use cigarettes

	Baseline e-cigarette use			
	Never	Tried	Infrequent	Frequent
		(1–2 times)	(1/month–1/week)	(>1/week)
Cigarette Use	n (%)	n (%)	n (%)	n (%)
A. Cross-sectional relationships at baseline (n=2836)				
Never	1743 (61.5)	407 (14.4)	40 (1.4)	6 (0.2)
Once	90 (3.2)	201 (7.1)	57 (2.0)	10 (0.4)
Used to	20 (0.7)	59 (2.1)	38 (1.3)	22 (0.8)
Rarely (<1/week)	8 (0.3)	15 (0.5)	31 (1.1)	19 (0.7)
Occasional (1–6/week)	1 (0.0)	6 (0.2)	20 (0.7)	10 (0.4)
Frequent (>6/week)	5 (0.2)	7 (0.2)	6 (0.2)	15 (0.5)
B. Longitudinal relationships for baseline never users of cigarettes (n=1726)				
Never	1259 (72.9)	211 (12.2)	13 (0.8)	1 (0.1)
Once	86 (5.0)	65 (3.8)	8 (0.5)	0 (0.0)
Used to smoke	19 (1.1)	19 (1.1)	1 (0.1)	1 (0.1)
Rarely (<1/week)	11 (0.6)	12 (0.7)	1 (0.1)	0 (0.0)
Occasional (1–6/week)	5 (0.3)	3 (0.2)	2 (0.1)	0 (0.0)
Frequent (>6/week)	3 (0.2)	1 (0.1)	3 (0.2)	2 (0.1)
C. Longitudinal relationships for baseline triers of cigarettes (n=318)				
No change	61 (19.2)	131 (41.2)	43 (13.5)	14 (4.4)
Escalation	9 (2.8)	38 (11.9)	17 (5.3)	5 (1.6)

Data analysis

We tested for differences on each baseline measure between adolescents who had complete versus missing values on one or more measures using χ^2 tests and t-tests. Among respondents completing all measures, we report descriptives on baseline measures for three subsamples: full cross-sectional sample, longitudinal subsample of baseline never users of cigarettes and longitudinal subsample of baseline occasional users of cigarettes. The relationship between e-cigarette and cigarette use was examined next in the same three subsamples. Self-rated smoking was validated against breath CO levels at baseline and follow-up using Games–Howell post hoc tests based on 1000 bootstrapped resamples because the data were skewed and had unequal variances.

Given the problems with imputing values for outcome variables,[27] attrition analyses were used to assess biases in all baseline measures in those with and without matched follow-up data (at follow-up 1=data missing; 0=data available) in the two longitudinal subsamples using multilevel logistic regressions (in R) to assess model fit (Akaike Information Criterion) and, for each predictor, the odds ratios (OR), 95% CIs and p value. The main analyses used the same analysis to predict follow-up initiation (1=smoked; 0=never smoked) or escalation (0=never, once or used to smoke cigarettes; 1=rarely, occasional or frequent cigarette smoking) of smoking based on ever use of e-cigarettes and covariates. E-cigarette use was dichotomised into never versus ever use due to few regular users. Model 1 controlled for the clustering of adolescents within schools, and baseline e-cigarette ever use was a predictor; model 2 added baseline covariates; and model 3 tested interactions between each covariate and e-cigarettes ever use. To assess the impact of baseline missing values, we repeated the regressions with imputation.[28]

RESULTS

Sample description

At baseline, full data were available on 2836 adolescents, who did not differ (p>0.05) from those with missing data (N=58–92) on all measures except sex (p=0.001; boys less likely to have complete data) and norms (p=0.02; those with lower norms to not smoke less likely to have complete data).

Table 1 provides descriptive data on baseline measures for respondents who completed all measures. The cross-sectional sample (table 1) was mostly aged 13 years, approximately half boys, and a majority not having ever used e-cigarettes or cigarettes. Levels of e-cigarette awareness and use were lower in the never smoking subsample (table 1: 80.0% heard of, 19.9% used e-cigarettes) compared with the subsample reporting occasional smoking (table 1: 90.0% heard of, 78.0% used e-cigarettes).

At baseline and follow-up, CO levels were low and not significantly different between those reporting they never smoked, had only tried smoking once, used to smoke sometimes or smoked sometimes but not as many as one per week; CO levels were significantly higher (p<0.05) among those reporting they smoked 1–6 or >6 cigarettes per week but not significantly different across these latter two categories.

Simple relationships between use of e-cigarettes and cigarettes

Table 2 reports the relationship between e-cigarette and cigarette use in the three subsamples. Table 2A shows the cross-sectional relationship: 61.5% of the sample had tried neither e-cigarettes nor cigarettes, 16.0% had tried e-cigarettes but not cigarettes, 4.4% had tried cigarettes but not e-cigarettes and 18.2% had used both.

Table 2B shows the longitudinal relationship between baseline e-cigarette use and follow-up cigarette use in the baseline

Table 3 Association of baseline measures with missingness (1=absent) at follow-up for baseline never used cigarettes (n=2196; left-hand column) and baseline once or used to use cigarettes (n=497; right-hand column)

	Baseline never used cigarettes		Baseline once or used to use cigarettes	
Predictors	**OR (95% CI)**	**p Value**	**OR (95% CI)**	**p Value**
Never used e-cigarettes	1.00		1.00	
Ever used e-cigarettes	1.11 (0.85 to 1.46)	0.43	0.83 (0.51 to 1.35)	0.44
Friend smokers= none	1.00		1.00	
Friend smokers=a few	1.18 (0.93 to 1.49)	0.18	2.08 (1.12 to 3.82)	0.019
Friend smokers= most	1.36 (0.78 to 2.39)	0.28	4.33 (2.10 to 8.95)	<0.001
Male	1.00		1.00	
Female	0.70 (0.56 to 0.86)	<0.001	0.84 (0.6 to 1.26)	0.40
Family smokers = none	1.00		1.00	
Family smokers = one	1.29 (0.99 to 1.67)	0.057	0.90 (0.47 to 1.71)	0.74
Family smokers = two	1.10 (0.79 to 1.51)	0.58	0.97 (0.50 to 1.89)	0.93
Family smokers = three or more	1.53 (1.10 to 2.12)	0.01	0.81 (0.43 to 1.53)	0.51
Intentions	0.77 (0.62 to 0.96)	0.02	0.99 (0.71 to 1.38)	0.95
Attitudes	0.93 (0.65 to 1.31)	0.66	1.29 (0.86 to 1.93)	0.22
Norms	0.95 (0.66 to 1.37)	0.78	0.99 (0.65 to 1.52)	0.97
Perceived behavioural control	0.91 (0.73 to 1.14)	0.42	0.64 (0.46 to 0.88)	0.006
Self-efficacy	1.25 (0.95 to 1.64)	0.11	1.15 (0.79 to 1.67)	0.46
Free school meals	1.03 (0.97 to 1.08)	0.34	1.01 (0.97 to 1.06)	0.49

Baseline never used cigarettes, AIC=2222.6; baseline once or used to use cigarettes, AIC=658.7.

never smokers; initiation of cigarette use in the next 12 months rose from 9.0% to 34.4%, respectively, in baseline never versus ever used e-cigarettes. Baseline CO levels were low among the self-reported never smokers, and exclusion of adolescents with higher baseline CO levels (>2 ppm) did not substantively change the regression findings. CO levels at follow-up were significantly higher among those classified as initiating compared with not initiating cigarette use ($p<0.05$).

Table 2C shows the longitudinal relationship between e-cigarette use at baseline and escalation of cigarette use at follow-up among baseline occasional smokers; escalation in the next 12 months rose from 12.9% to 24.2%, respectively, in those never versus ever having used e-cigarettes at baseline. Baseline CO levels were low among those self-reporting that they had only once used or former smokers and exclusion of adolescents with higher baseline CO levels (>2 ppm) did not substantively change the regression findings. CO levels at follow-up were significantly higher among those classified as escalating versus not escalating smoking ($p<0.001$).

Attrition analyses

At baseline, 2196 adolescents (77.4%) reported never having smoked but only 1726 adolescents (78.6%) could be matched across time points. The similar number of adolescents completing questions at each time point (total N=2928 and 2747 at baseline and follow-up, respectively) suggests that attrition was principally due to a failure to match personally generated codes.

Analyses (table 3) indicated no significant effects for baseline ever used e-cigarettes, friends' smoking, attitude, norms, perceived behavioural control, self-efficacy or free school meals on missingness; however, there were significant effects for sex (OR 0.70, 95% CI 0.56 to 0.86; girls less likely to be missing), family smoking (OR 1.53, 95% CI 1.10 to 2.12; with three or more family members who smoked more likely to be missing) and intention (OR 0.77, 95% CI 0.62 to 0.96; with weaker intentions not to smoke more likely to be missing).

At baseline, 497 adolescents reported trying or past use of cigarettes. We matched 318 adolescents (64.0%) across time points. Analyses indicated no significant effects for baseline ever used e-cigarettes, sex, family smoking, intention, attitude, perceived behavioural control, self-efficacy and free school meals on missingness (table 3); however, there were significant effects for friends' smoking (OR 2.08, 95% CI 1.12 to 3.82 for few friends smoking; OR 4.33, 95% CI 2.10 to 8.95 for most friends smoking; with a few or most friends who smoked more likely to be missing) and perceived behavioural control (OR 0.64, 95% CI 0.46 to 0.88; with weaker perceived behavioural control over not smoking more likely to be missing).

Prospective analyses

Initiation of cigarette use at follow-up was predicted by having ever used e-cigarettes at baseline (table 4, model 1; OR 5.38, 95% CI 4.02 to 7.22) and remained so when controlling for covariates (table 4, model 2; OR 4.06, 95% CI 2.94 to 5.60). Initiation of cigarette use was significantly higher in adolescents who at baseline were ever users of e-cigarettes, had either a few or most friends who smoked and had one, two or three or more family members who smoked, but was significantly lower in adolescents with stronger intentions (not to smoke). Exploratory analyses revealed that baseline friends' smoking was a statistically significant moderator ($p<0.001$; all other moderators $p>0.43$). Decomposition of the moderation effect (table 4, model 3) indicated that the the impact of ever used e-cigarettes on likelihood of initiating cigarette use was attenuated among those with a few or most friends who smoked at baseline. Multiple imputation resulted in an additional 28 cases in this analysis. The estimated model coefficients showed very little change (mostly <1%), and there was no change in the interpretation.

Table 4 also reports the results of the regressions to predict escalation of cigarette use at follow-up. In model 1, ever use of e-cigarettes at baseline was a significant predictor of escalation of cigarette use (OR 2.16, 95% CI 1.01 to 4.62). In model 2, ever use of e-cigarettes at baseline became a non-significant predictor of escalation when controlling for covariates (OR 1.89, 95% CI 0.82 to 4.33). Escalation of cigarette use was significantly higher in adolescents who had most friends who

Table 4 Association of baseline ever used e-cigarettes with ever used cigarettes at follow-up (among never users of cigarettes at baseline; n=1726; left-hand column) or increased use of cigarettes at follow-up (among baseline once or used to use cigarettes; n=318; right-hand column) controlling for clustering by school

	Baseline never used cigarettes		Baseline once or used to use cigarettes	
Predictors	**OR (95% CI)**	**p Value**	**OR (95% CI)**	**p Value**
Model one without covariates				
Never used e-cigarettes	1.00		1.00	
Ever used e-cigarettes	5.38 (4.02 to 7.22)	<0.001	2.16 (1.01 to 4.62)	0.046
Model two with covariates				
Never used e-cigarettes	1.00		1.00	
Ever used e-cigarettes	4.06 (2.94 to 5.60)	<0.001	1.89 (0.82 to 4.33)	0.13
Friend smokers = none	1.00		1.00	
Friend smokers = a few	1.87 (1.35 to 2.58)	<0.001	1.15 (0.50 to 2.66)	0.75
Friend smokers = most	2.99 (1.52 to 5.87)	0.001	3.23 (1.19 to 8.77)	0.022
Male	1.00		1.00	
Female	1.32 (0.97 to 1.79)	0.08	0.83 (0.45 to 1.52)	0.55
Family smokers = none	1.00		1.00	
Family smokers = one	0.76 (0.51 to 1.13)	0.18	1.69 (0.61 to 4.68)	0.31
Family smokers = two	2.05 (1.37 to 3.06)	<0.001	1.41 (0.48 to 4.12)	0.53
Family smokers = three or more	1.90 (1.23 to 2.94)	0.004	1.23 (0.45 to 3.41)	0.69
Intentions	0.70 (0.52 to 0.96)	0.03	1.50 (0.87 to 2.57)	0.14
Attitudes	0.68 (0.44 to 1.04)	0.08	0.51 (0.28 to 0.90)	0.020
Norms	0.89 (0.57 to 1.39)	0.61	1.12 (0.56 to 2.23)	0.75
Perceived behavioural control	1.00 (0.73 to 1.37)	0.99	0.99 (0.58 to 1.69)	0.96
Self-efficacy	1.09 (0.75 to 1.57)	0.66	0.57 (0.35 to 0.94)	0.027
Free school meals	0.99 (0.97 to 1.02)	0.60	1.01 (0.96 to 1.07)	0.62
Model three with covariates and interactions				
Never used e-cigarettes and Friend smokers = none	1.00			
Ever used e-cigarettes and friend smokers = none	7.74 (4.68—12.79)	<0.001		
Never used e-cigarettes and Friend smokers = a few	2.57 (1.72 to 3.84)	<0.001		
Ever used e-cigarettes and friend smokers = a few	7.84 (5.08–12.09)	<0.001		
Never used e-cigarettes and friend smokers = most	6.32 (2.68 to 14.91)	<0.001		
Ever used e-cigarettes and friend smokers = most	8.75 (3.68–20.83)	<0.001		
Male	1.00			
Female	1.37 (1.01 to 1.86)	0.04		
Family smokers = none	1.00			
Family smokers = one	0.76 (0.51 to 1.14)	0.19		
Family smokers = two	2.02 (1.35 to 3.03)	<0.001		
Family smokers = three or more	1.87 (1.21 to 2.90)	0.005		
Intentions	0.70 (0.52 to 0.96)	0.03		
Attitudes	0.67 (0.44 to 1.01)	0.06		
Norms	0.91 (0.59 to 1.41)	0.69		
Perceived behavioural control	1.00 (0.73 to 1.37)	0.99		
Self-efficacy	1.09 (0.75 to 1.59)	0.65		
Free school meals	0.99 (0.96 to 1.02)	0.47		

Follow-up ever used cigarettes: model without covariates, AIC=1281.3; model with covariates, AIC=1226.5; model with covariates and interactions, AIC=1218.7; follow-up escalation of cigarette use: model without covariates, AIC=334.1; model with covariates, AIC=327.5.

smoked, but was significantly lower in those adolescents with stronger attitudes (not to smoke) and intentions (not to smoke). Exploration of moderation effects revealed that two interactions were statistically significant (attitudes, p=0.01; intentions, p=0.02), although decomposition of these effects did not reveal significant effects of e-cigarette use on escalation of cigarette use at different levels of either moderator (p>0.20). None of the other moderators approached statistical significance (p>0.16). Multiple imputation did not change any values or the analyses.

The ORs based on logistic regression analyses reported in table 4 may overestimate the degree of association between e-cigarette use and subsequent smoking because the prevalence of the outcome exceeds the usual 15% cut-off. To assess the degree of overestimation, we ran the initial models (model 1 in table 4) using a log binomial model. For the analyses of never smokers, the degree of association was reduced but remained statistically significant: incidence relative risk (IRR) was 3.85 (95% CI 3.07 to 4.82), p<0.001. For the analyses of smoking escalation, the degree of association was also reduced and no longer statistically significant: IRR=1.81 (95% CI 095 to 3.44), p=0.071.

DISCUSSION

We showed that ever use of e-cigarettes is associated with initiation of cigarette use; an effect that remains when controlling for various predictors of smoking. Our study in UK adolescents

(13–14 years old) found patterns similar to those reported in longitudinal studies among adolescents aged 13–14 years and older[16–19] in the USA with comparable sized ORs (the IRR was also of a comparable magnitude). Together, these studies suggest that it is unlikely that the high rates of dual use of e-cigarette and cigarette use observed in the USA[5–7] and UK[8–15] in cross-sectional surveys of adolescents are entirely attributable to cigarette users subsequently taking up e-cigarettes. A significant minority of adolescents try e-cigarettes first (19.9% here) and later initiate cigarette use. Our findings also indicated that the association between ever use of e-cigarettes and initiation of cigarette use was particularly strong among adolescents with no friends who smoked, a group usually considered to be less susceptible to smoking initiation (see the study by Barrington-Trimis *et al*[16] for similar moderation effect among those with low intentions to smoke). In relation to escalation of cigarette use, the OR showed that ever use of e-cigarettes is associated with subsequent escalation, although this effect was attenuated when using the IRR or when controlling for covariates. However, given the limited numbers escalating their cigarette use in this study and lack of support in other studies, these findings should be treated cautiously (eg, other studies either did not find e-cigarette use to be related to change in frequency of smoking among baseline ever-smokers,[19] or found that baseline frequency of use of e-cigarettes was only associated with follow-up smoking frequency among baseline non-smokers and not among baseline infrequent or frequent smokers[29]).

Our research provides limited insights into the mechanism relating ever use of e-cigarettes to subsequent initiation and escalation of cigarette use. In principle, it is possible that e-cigarette use in adolescents is a marker for those who would have initiated or escalated cigarette use even if e-cigarettes had not been available. Among such adolescents, the availability of e-cigarettes may have simply delayed initiation or escalation. However, at least in relation to initiation, the fact that e-cigarette use was a bigger risk factor in groups considered least at risk (ie, no friends who smoke at baseline) argues against this (see the study by Barrington-Trimis *et al*[19] for a similar moderator effect also difficult to reconcile with this explanation). It is also plausible that the use of e-cigarettes might lead to initiation and escalation in cigarette use by normalising any kind of nicotine use, by developing nicotine addiction (if the e-cigarettes contain nicotine) or by developing friendship networks with smokers and decreasing the perceived risks of smoking.[30–32] However, there is no direct evidence yet to suggest that ever use of e-cigarettes normalises cigarette use.

Given the lack of clarity regarding the mechanism linking e-cigarette and cigarette use, we need to be cautious in making policy recommendations based on our findings. We acknowledge that since our survey, UK legislation has been put in place, including bans on marketing and selling e-cigarettes to minors. UK agencies are required to enforce age of sale, child and tamper proof packaging and display age of sale signage and health warnings on e-cigarette packaging. Nevertheless, our findings emphasise the value of regulating the marketing and sale of e-cigarettes to minors in countries without such measures, particularly given that e-cigarette advertising has been shown to reduce perceived harm of occasional smoking.[33]

Our study's strengths include a large demographically diverse sample, measurement of e-cigarette and cigarette use over 12 months, exploration of initiation and escalation of cigarette use, validation of smoking measures and exploration of covariates and moderators not previously examined. There are also weaknesses. First, our study had a relatively high attrition. This was principally attributable to problems in matching participants' personally generated anonymous codes, although attrition analyses indicated relatively modest biases in the final compared with initial sample. Second, like other similar studies, we focused on self-reported e-cigarette and cigarette use. Although we validated the self-reported smoking against an objective measure of CO, we did not have a way of validating e-cigarette use. Third, we failed to distinguish types of e-cigarette use (e-cigarettes vary in a number of ways, including the delivery method and whether they contain nicotine). Furthermore, our description of e-cigarettes and the timing of our survey might have restricted our study to first-generation devices, in which their nicotine delivery profile mimic less closely to cigarettes than do more recent generations.[34] Exploring relationships between use of new generations of e-cigarettes both containing nicotine or not and subsequent cigarette use is an important issue for further research. The current research focused on cigarette use, although other studies have reported similar effects with various tobacco products.[18]

A fourth limitation concerns our main analyses (table 4), which were restricted to ever use of e-cigarettes, and we were unable to test whether more regular use of e-cigarettes was more strongly associated with initiating or escalating cigarette use (see table 2; see the study by Warner[6] for cross-sectional data). Relatedly, our analyses of impacts on escalation should be treated cautiously given the limited numbers escalating cigarette use during the period studied and the fact that our findings conflict with published work.[19] Fifth, our research was restricted to a limited geographical area (two English counties), although it did extend findings from several US states. Sixth, our research focused on a limited age range (baseline: 13–14 years; most published studies[17–19] are with this age group). Future studies should explore effects in different aged adolescents and over varying time periods. Finally, our research could only consider a finite number of covariates and moderators, and it is plausible that important factors were omitted. Previous related studies[16–19] have examined various other factors (eg, sensation seeking, impulsivity, other substance use, delinquent behaviour, academic performance and race/ethnicity). It would be valuable to test these additional covariates and moderating variables in future work.

In summary, this is the first study to report longitudinal relationships between ever use of e-cigarettes and initiation or escalation of cigarette use among UK adolescents. Despite measuring and accounting for the influence of a broad range of variables in this and other studies,[16–19] it is possible that any third variables could have been responsible for the observed relationships. Therefore, while acknowledging that a causal relationship may be plausible, we cannot confirm this based on our findings and the trends observed over the same time period in the UK; rates of e-cigarette use have increased, but the rates of cigarette use have continued to decline. Future research could seek to disentangle these apparently contrary findings and assess dose–response relationships between e-cigarette and cigarette use over longer-time periods in a broader age range of adolescents while controlling for a range of covariates and assessing the impact of antismoking interventions.

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What this paper adds

Previous research: In cross-sectional surveys of UK adolescents, electronic cigarette (e-cigarette) use is increasing, cigarette use is decreasing and increasing numbers of adolescents report using both e-cigarettes and cigarettes. Several studies among US adolescents suggest that self-reported e-cigarette use is associated with subsequent initiation of cigarette use, whereas one study in US adolescents found no association between e-cigarette use and escalation of cigarette use. However, these studies were all conducted in the USA, did not validate their self-reported smoking measures against objective measures and assessed only a limited range of risk factors for smoking as covariates and moderators of these relationships.
Interpretation: Associations similar to those found in the previous studies are reported in a sample of UK adolescents and are validated against breath CO measures. Data collected over a 12-month period confirmed a sizeable relationship between ever use of e-cigarettes and subsequent initiation of cigarette use and showed that e-cigarette use is modestly associated with subsequent escalation of cigarette use. The former but not the latter relationship remained after controlling for various other risk factors for smoking (eg, intentions to smoke), only some of which had been assessed in previous studies. These findings support the robustness of the relationship between ever use of e-cigarettes and initiation of cigarette use but suggest the relationship between ever use of e-cigarettes and escalation of cigarette use may be explainable by other factors. Ever use of e-cigarettes was a stronger predictor of initiation of cigarette use in those with no friends who smoked at baseline compared with those with a few or most friends who smoked at baseline. The latter finding would not appear to be consistent with the suggestion that e-cigarette use may simply be a marker for those who would go on to smoke cigarettes even without having tried e-cigarettes.

of major outputs. The authors of this article affirm that the manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Contributors MC had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: MC, SG, RL, CJA, CT, RW and KS . Acquisition, analysis or interpretation of data: MC, SG, RSE, KF, BSM, LC, RL, CJA, DM, CT, RW and KS . Drafting of the manuscript: MC and SG. Critical revision of the manuscript for important intellectual content: MC, SG, RL, CJA, DM, CT, RW and KS. Statistical analysis: RW and MC. Obtained funding: MC, SG, CJA, CT, RW and KS. Administrative, technical or material support: RS-E, KF, BSM and LC. Study supervision: MC, SG, RL and DM.

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Relationship between trying an electronic cigarette and subsequent cigarette experimentation in Scottish adolescents: a cohort study

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ABSTRACT

Background This study examines whether young never smokers in Scotland, UK, who have tried an e-cigarette are more likely than those who have not, to try a cigarette during the following year.

Methods Prospective cohort survey conducted in four high schools in Scotland, UK during February/March 2015 (n=3807) with follow-up 1 year later. All pupils (age 11–18) were surveyed. Response rates were high in both years (87% in 2015) and 2680/3807 (70.4%) of the original cohort completed the follow-up survey. Analysis was restricted to baseline 'never smokers' (n=3001/3807), 2125 of whom were available to follow-up (70.8%).

Results At baseline, 183 of 2125 (8.6%) never smokers had tried an e-cigarette and 1942 had not. Of the young people who had not tried an e-cigarette at baseline, 249 (12.8%) went on to try smoking a cigarette by follow-up. This compares with 74 (40.4%) of those who had tried an e-cigarette at baseline. This effect remained significant in a logistic regression model adjusted for smoking susceptibility, having friends who smoke, family members' smoking status, age, sex, family affluence score, ethnic group and school (adjusted OR 2.42 (95% CI 1.63 to 3.60)). There was a significant interaction between e-cigarette use and smoking susceptibility and between e-cigarette use and smoking within the friendship group.

Conclusions Young never smokers are more likely to experiment with cigarettes if they have tried an e-cigarette. Causality cannot be inferred, but continued close monitoring of e-cigarette use in young people is warranted.

INTRODUCTION

In the UK and many other countries, e-cigarette use among young people is largely confined to those who have already tried tobacco and is mostly experimental in nature.[1 2] That is, most young people who have never tried tobacco smoking, hereon referred to as never-smokers, do not engage in regular e-cigarette use that is sustained over time. Nevertheless, there remains concern that trying an e-cigarette could ease the pathway to experimentation with tobacco smoking for young never-smokers.

Eight longitudinal studies, all conducted in the USA with follow-up after 6[3 4] and/or 12 months,[5–10] have explored the relationship between e-cigarette use and smoking initiation in young never-smokers. They found that young people who had ever used an e-cigarette at baseline were more likely to have tried a cigarette by follow-up.

Most of the evidence from prospective cohort studies of young never smokers, e-cigarette use and smoking initiation has come from the USA. It is important this evidence can be compared with studies from different countries because varied national contexts, such as different tobacco control regulations, historical and cultural factors around tobacco use, availability and supply of products, ethnic composition of the population and investment in advertising of products, make it difficult to generalise findings across national boundaries. For example, in Poland 27.4% of adolescents report using an e-cigarette in the past month.[11] Poland is a major European tobacco and e-cigarette producer. Recently smoking rates have increased among Polish female adolescents although they are stable in men[12–14] and by late adolescence most Polish e-cigarette users are dual users (tobacco and e-cigarette use). A recent study found 21.8% of students (16–18 years) were dual users and this was not associated with reduced cigarette consumption compared with tobacco-only users.[15] The case of Poland highlights the potential role of national factors such as tobacco production and industry involvement in affecting levels of use in young people.

In Scotland, the prevalence of cigarette smoking among young people has steadily fallen over the last two decades. In 2015, only 2% of 13 year olds and 7% of 15 year olds were regular smokers.[16] However, current smoking among young people aged 16–24 years in Scotland is significantly higher at 21%.[17] This disparity suggests that smoking initiation may now be delayed until early adulthood. Therefore early risk factors for later smoking initiation require further investigation.

Previous cross-sectional research has shown a positive association between e-cigarette use and weakened intentions not to smoke in children aged 10–11 years in Wales.[1] Recently the ever use of e-cigarettes among young non-smokers has increased in Scotland with 10% of non-smoking 15 year olds having tried them in 2013 and 24% in 2015.[16] Levels of regular e-cigarette use among young people in Wales have also increased with 2.7% of young people aged 11–18 years reporting using them at least once a week in 2015.[18] These increases were preceded by a marked growth in the

Table 1 Number of 'never smoking' respondents by school and year group

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
School 1 Accessible small town/medium–low deprivation	207 24.1%	184 21.5%	193 22.5%	129 15.0%	93 10.8%	52 6.1%	858 100%
School 2Urban/medium–low deprivation	147 19.9%	175 23.7%	136 18.4%	134 18.2%	85 11.5%	61 8.3%	738 100%
School 3 Other urban/high deprivation	177 26.3%	160 23.8%	106 15.8%	125 18.6%	62 9.2%	42 6.3%	672 100%
School 4 Urban/high deprivation	151 20.6%	197 26.9%	122 16.6%	126 17.2%	94 12.8%	43 5.9%	733 100%
Total	682	716	557	513	333	197	3001
Mean age (SD)	12.5 (0.34)	13.5 (0.34)	14.6 (0.34)	15.6 (0.35)	16.6 (0.36)	17.6 (0.32)	14.4 (1.58)

retail availability of e-cigarettes with the proportion of retailers with displays of e-cigarettes doubling between 2013 and 2014.[19] When this study was conducted, within store advertising and promotion of e-cigarettes was not regulated and there was no age restriction on the legal purchase of e-cigarettes in the UK. This study is one of the first to examine e-cigarette use and cigarette experimentation in a UK longitudinal sample.

METHODS

The data presented here are drawn from the Determining the Impact of Smoking Point-of-Sale Legislation Among Youth (DISPLAY) study.[20] The DISPLAY study is a 5-year multimodal study designed to measure the impact of UK legislation to ban point-of-sale displays of tobacco products on the smoking attitudes and behaviours of young people. One element of the DISPLAY study is an annual school survey conducted in four Scottish secondary schools located in communities that differ in terms of their socioeconomic and urban–rural profiles. The data presented here are from the 2015 and 2016 surveys which included all pupils (aged 11–18) in the four schools. All four schools had pupils across the age range 11–18 years and a breakdown of participant numbers by school and by year group is given in table 1. The survey was administered by class teachers under exam conditions and took on average 40 min to complete. Pupils who were absent on the day of the survey were given opportunity during the following 2 weeks to complete the survey.

Ethical approval was obtained from the University of St Andrews, University Teaching and Research Ethics Committee (UTREC). Parental opt-out consent was obtained prior to pupils completing the survey. Pupils also provided active consent by completing the survey.

Derivation of variables

Smoking status

Respondents were asked "Have you ever smoked cigarettes or hand-rolled cigarettes (roll-ups), even if it is just one or two puffs?" to which they could respond 'yes' or 'no'. Young people who responded 'no' were deemed to be never-smokers at that point.

E-cigarette use

Respondents were asked whether or not they had heard of e-cigarettes. Pupils who answered that they had not heard of e-cigarettes were routed past further questions on e-cigarettes. Pupils that had heard of e-cigarettes were then asked "Which ONE of the following is closest to describing your experience of e-cigarettes/vapourisers/shisha pens?" with response options of 'I have never used them', 'I have tried them once or twice', 'I use them sometimes (more than once a month)' or 'I use them often (more than once a week)'. Young people who responded that they had never heard of e-cigarettes were coded as having 'never used them'.

For the logistic regression analysis, due to low frequencies in the categories reflecting regular use, participants were divided into those who had never tried e-cigarettes versus those who had tried e-cigarettes.

Susceptibility to smoking

Susceptibility to smoking was assessed through two questions "If one of your friends offered you a cigarette or hand-rolled cigarettes (roll-ups), would you smoke it?" and "Do you think you will smoke a cigarette or hand-rolled cigarettes (roll-ups) at any time during the next year?". The response option for these questions was 'definitely yes', 'probably yes', 'probably not' and 'definitely not'. If respondents answered anything other than 'definitely not' to either of these questions then they were coded as being susceptible to smoking. These measures of smoking susceptibility have been used in related studies[6] and are based on validated measures.[21]

Number of friends and family who smoke

Respondents were asked "How many of your friends smoke cigarettes or hand-rolled cigarettes (roll-ups)?" and could respond 'most of them', 'about half of them', 'some of them', 'none of them' or 'don't know'. 'Don't know' responses were coded as missing and then a binary variable was generated distinguishing those who responded 'none of them' versus any other response.

Respondents were asked "which if any of the following people smoke cigarettes or hand rolled cigarettes (roll-ups)?". Options included their mother or female carer, father or male carer, brother (eldest if more than one) and sister (eldest if more than one). A binary variable was created splitting participants who had responded that any of these family members smoked versus those that reported no smokers in their immediate family.

Demographic variables

Respondents were asked their gender, ethnic group and date of birth. Individual family material well-being was assessed through the Family Affluence Scale (FAS).[22] The FAS consists of four questions (own bedroom, number of family cars, number of computers and number of family holidays abroad per year). The FAS raw scores were transformed though categorical principal component analysis into single-dimensional scores that were then divided into tertiles of high, medium and low FAS.

Analysis

Analysis was conducted in Stata V.14 (StataCorp).

Never smokers were divided into those who had tried an e-cigarette at baseline and those who had not and these groups were compared in terms of the proportion of participants that reported having experimented with cigarettes by follow-up. Tobacco experimentation in this study was defined as any cigarette use, even just one or two puffs.

Multivariate logistic regression was used to control for potential confounding factors—sex, age, ethnicity, family affluence, smoking within the family, smoking by friends and susceptibility to smoking. The model was built in three blocks, first with only e-cigarette use and smoking-related variables as independent variables and in the second block demographic variables were added and an indicator for school was included in the model. Including school as a covariate makes explicit the effect of school as school-level smoking norms are an important influence on smoking behaviour.[23] In the third block interactions between e-cigarette use, smoking susceptibility and smoking within friendship group were included. The risk ratio (RR) for the unadjusted model was obtained from a binomial log-linear regression and for the adjusted models a Poisson regression model with a robust variance estimator.[24]

To test the effect of missing data on the parameter estimates, we used multiple imputation by chained equations (Stata V.14: mi impute chained). Further information on the imputation procedure is given in the online supplementary materials.

RESULTS

Sample characteristics

In 2015, there were 3001 never smokers in our sample, of these 9.4% had tried an e-cigarette. Twenty-six per cent were coded as susceptible to smoking, 32.8% had a family member who smoked and 23.8% reported having at least one friend who smoked.

Our final sample included 2125 young people for whom we had data on e-cigarette use and smoking status at baseline and follow-up. Of these, 183 (8.6%) had tried an e-cigarette at baseline and 1942 (91.4%) had not. Table 1 shows the year group distribution of the sample by school.

Relationship between baseline e-cigarette use and smoking status at follow-up in baseline never smokers

Of the young people who had tried an e-cigarette at baseline (n=183), 74 (40.4%) went on to initiate smoking cigarettes by follow-up. This compares with 249 (12.8%) of those who reported never having used an e-cigarette at baseline (n=1942) and went on to initiate smoking cigarettes by follow-up. Table 2 shows the bivariate relationship between e-cigarette use in 2015 and smoking status in 2016.

Logistic regression on 'experimented with cigarettes by follow-up'

Baseline e-cigarette use is a significant predictor of experimentation with cigarettes. In an unadjusted model, the OR for ever-smoking at follow-up in ever e-cigarette users versus never e-cigarette users was 4.62 (95% CI 3.34 to 6.38), giving a RR of 3.15 (95% CI 2.55 to 3.89). Table 3 below shows the ORs, p values and 95% CIs for the OR for each of the models. All the models below were adjusted for sex, age centred on the mean (ie, individual age minus the mean age of the sample) FAS, ethnic group and school.

Model 1 RR for e-cigarette use is 1.72 (95% CI 1.31 to 2.26), model 2 RR for e-cigarette use is 4.09 (95% CI 2.57 to 6.52), RR for e-cigarette*susceptibility interaction is 0.43 (95% CI 0.25 to 0.72), RR for e-cigarette*friend smokes interaction 0.62 (95% CI 0.39 to 0.99), model 3 RR for e-cigarette use is 4.22 (95% CI 2.83 to 6.36), RR for e-cigarette*susceptibility interaction is 0.41 (95% CI 0.26 to 0.64) and RR for e-cigarette*friend smokes interaction 0.65 (95% CI 0.44 to 0.97).

Figure 1 shows that the impact of having tried an e-cigarette at baseline on probability of tobacco experimentation at follow-up is much greater for young people who were non-susceptible to smoking at baseline. The contrast of predicted probabilities is significant ($\chi^2=53.93, p<0.001$).

Figure 2 shows that the impact of having tried an e-cigarette at baseline on probability of tobacco experimentation at follow-up is much greater for young people who have no friends who smoke. The contrast of predicted probabilities is significant ($\chi^2=4.91$, $p=0.042$).

Further information on characteristics of missing cases is given in online supplementary materials. To test the effect of missing data on our parameter estimates we used multiple imputation by chained equations. Model 3 shows the estimates from an imputed model (m=100). The model estimates are stable under complete case analysis and imputation.

DISCUSSION

This study found that young 'never-smokers' who had tried an e-cigarette were more likely to try a cigarette during the following year than young never-smokers who had not tried an e-cigarette. This is consistent with the results of all previous

Table 2 Baseline e-cigarette use in 2015 and follow-up smoking status in 2016

		Have you ever smoked cigarettes or roll-ups, even if it is just one or two puffs? (2016)		
		No	Yes	Total
E-cigarette use (2015)	I have never used an e-cigarette	1693	249	1942
		87.2%	12.8%	100%
	I have only used them once or twice	104	65	169
		61.5%	38.5%	100%
	I use them sometimes (monthly)	3	5	8
		37.5%	62.5%	100%
	I use them often (weekly)	2	4	6
		33.3%	66.7%	100%
Total		1802	323	2125
		84.9%	15.2%	100%

Table 3 Multivariate logistic regressions on 'ever smoked a cigarette' in 2016

Variable	Model 1—adjusted main effects model (n=1806)			Model 2—adjusted model including interactions (n=1806)			Model 3—imputed model with interactions (n=2520)		
	OR	CI	p	OR	CI	p	OR	CI	p
E-cigarette ever use 2015	2.42	1.63 to 3.60	<0.001	5.97	3.12 to 11.40	<0.001	6.64	3.60 to 12.26	<0.001
Susceptibility to smoking 2015	3.65	2.70 to 4.94	<0.001	4.13	2.98 to 5.72	<0.001	5.19	3.74 to 7.21	<0.001
Any family member smokes 2015	1.89	1.40 to 2.56	<0.001	1.93	1.43 to 2.61	<0.001	1.83	1.37 to 2.44	<0.001
'At least some' friends smoke 2015	1.33	0.95 to 1.85	0.094	1.56	1.09 to 2.25	0.016	1.51	1.07 to 2.14	0.020
Interaction between e-cigarette and susceptibility				0.42	0.19 to 0.94	0.036	0.42	0.20 to 0.88	0.021
Interaction between e-cigarette and friends smoking				0.49	0.23 to 1.07	0.072	0.52	0.25 to 1.09	0.082

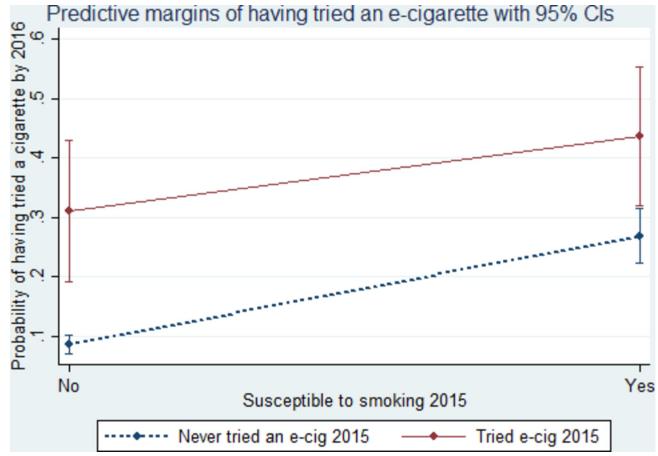

Figure 1 Marginal probabilities of cigarette experimentation by e-cigarette use and smoking susceptibility. e-cig, e-cigarette.

published longitudinal studies of the relationship between e-cigarettes and tobacco experimentation in young people from the USA,[3–9] providing further confirmation in a non-US context.

It is possible that the relationship between e-cigarettes and tobacco experimentation may not be causal if young never-smokers who try an e-cigarette would have gone on to initiate smoking anyway due to being already favourably disposed towards tobacco use. In other words, it is possible that e-cigarette use and tobacco experimentation have common liability[25] and the former is incidental to tobacco experimentation. To address this possibility, we controlled for factors associated with transition to smoking such as smoking susceptibility[26] and smoking among friends and family[27] in the analysis. However, even when these items were included in the model e-cigarette use remained a significant predictor of cigarette experimentation. Importantly, there was also an interaction between smoking susceptibility and e-cigarette use and between e-cigarette use and having friends who smoked. These data indicate that e-cigarette use had a greater effect on the odds of cigarette experimentation in young people not traditionally thought to be high risk, that is, those with a firm intention not to smoke and/or those with no smokers in their friendship group.

There is some evidence from other studies that young people who try e-cigarettes before tobacco have different characteristics to those who go straight to smoking. Wills and colleagues[28] found

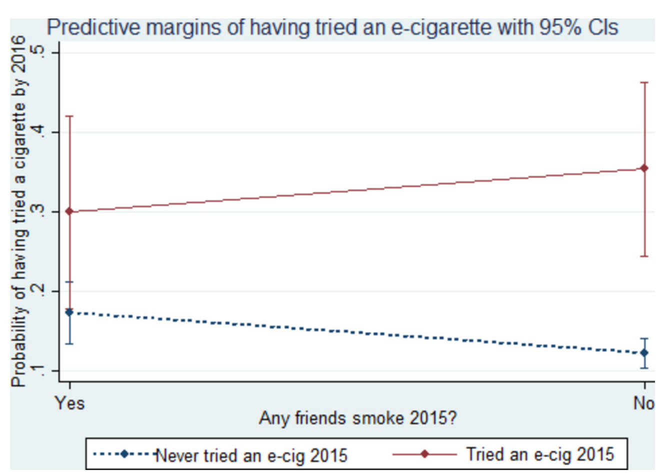

Figure 2 Marginal probabilities of cigarette experimentation by e-cigarette use and smokers within friendship. e-cig, e-cigarette.

that those who used an e-cigarette first were less rebellious and more likely to receive social support from their parents. Miech and colleagues[10] found that young never-smokers who had tried e-cigarettes were more likely to move away from the perception that cigarettes were a 'great risk' over the following year. Wills and colleagues[29] also found that young never smokers who used e-cigarettes were also more likely to increase their positive smoking expectancies (such as beliefs that smoking would make them more confident, help them relax and reduce boredom) and were more likely to become friends with smokers and subsequently try smoking. However, with only 1-year follow-up these studies were not able to determine whether changes in expectancies or affiliations preceded smoking. Further research on this topic is required over longer follow-up periods.

Schneider and Diehl have outlined a 'catalyst model' of e-cigarette influence on smoking uptake in adolescence.[30] This is intended as an alternative to 'gateway theory'[31 32] as an explanation of the relationship between e-cigarette and tobacco use. They break the process down into two stages: factors influencing transition from 'no use' to 'e-cigarette use' and then the factors influencing the second stage of transition from 'e-cigarette use' to 'tobacco use'. The first-stage mechanisms include easing the process of initial trial, for example, with sweet flavours. The second-stage mechanisms include increased accessibility and learning of smoking rituals. Thus, there are a number of paths within the catalyst model whereby e-cigarette use, even single trial, might facilitate smoking uptake. There are also pathways by which e-cigarettes could mitigate against a transition to regular smoking. For those young people who are curious to try the performative aspects of smoking (the hand to mouth action and inhalation process), the act of trying e-cigarettes may result in lower motivation to try tobacco smoking.

Levy and colleagues have modelled the public health impacts of e-cigarettes and estimate that under a range of conditions, e-cigarettes may have a positive net impact on public health at a population level because of the greater benefits conferred on smokers relative to the potential harm to young people.[33] Further studies could usefully examine e-cigarette use, smoking and smoking-related attitudes over longer time periods to determine the conditions under which e-cigarettes enhance adult quit rates without facilitating uptake in young people.

The importance of research findings about the relationship between e-cigarette use and smoking initiation has been debated on the basis that most e-cigarette use among young people is occasional and therefore unlikely to be directly harmful or be sufficient to influence other behaviours. However, some argue that the influence of e-cigarette experimentation may be psychosocial rather than chemical; it has been suggested that e-cigarettes '(convey) to young apprehensive would-be smokers that nicotine is a benign drug and potentially weaken the established message that smoking kills'.[34] E-cigarette advertising has emphasised the commonalities between the products with the message that e-cigarettes can give the psychological and social benefits of smoking without the health or social costs.[35] There are some signs that these messages confuse young people about the harms of smoking. For example, a recent study found that after viewing an e-cigarette advert young people were more likely to rate occasional cigarette smoking as less harmful.[36]

At the time this research was conducted there were no legal restrictions on sales or advertisement of e-cigarettes. However, in the UK e-cigarettes are now banned from sale to people under 18[37 38] and advertising on television, print media and radio is prohibited under the Tobacco Products Directive and associated UK regulations,[39 40] although at present point-of-sale marketing is still permitted. It will be important to ascertain if this legislation is sufficient to prevent or reduce the numbers of young people trying e-cigarettes.

Strengths and limitations

The strengths of this study are its prospective design, large sample and high response and follow-up rates. Importantly, the multiple imputation models indicate that model estimates are not biased by missing data. However, there are a number of limitations. First, most of the young people whom we categorised as having initiated smoking may have only taken one or two puffs of a cigarette during the follow-up period. Therefore, we do not know whether any of these young people will transition to regular smoking. Transition from never-smoker to smoker is often conceptualised as a multistep pathway.[41–43] Recent research suggests that any experimentation with cigarettes is a strong predictor of transition to regular smoking, with experimentation at baseline identifying two-thirds of regular smokers at 2-year follow-up with a false positive rate of only 8%.[44]

Second, participants were drawn from only four schools in Scotland and therefore may not be representative of the Scottish school population. However, comparison of the demographic characteristics of our sample with a nationally representative one does not indicate any significant deviation.[45] Third, the study is based on self-reports and we do not yet know the reliability of young people's self-reported use of e-cigarettes.

The age range of the sample (11–18 years) is broader than in some other research in this area. Therefore, we split our sample in half by age and repeated the analysis on the split samples. The results we obtained were the same and are presented in the online supplementary materials.

Finally, although we have used validated measures of smoking susceptibility, they were developed more than 20 years ago and there may be other aspects of common liability to tobacco and e-cigarette use that are not assessed by existing measures of susceptibility.

CONCLUSIONS

This UK longitudinal study found that young never-smokers who try e-cigarettes are at elevated risk of initiating smoking compared with young never-smokers who do not try e-cigarettes. Further research with longer follow-up is required to discover how many of the full sample of young people, if any, transition to regular smoking and to explore the longitudinal relationship between use of e-cigarettes and changes in attitudes to smoking. Careful and regular monitoring of smoking rates and e-cigarette use among young people is necessary over the

What this paper adds

- Eight prospective studies in the USA have reported a temporal relationship between trying an e-cigarette and subsequent experimentation with cigarettes.
- Consistent with the US studies, this study indicates a positive relationship between e-cigarette use in never smokers and their subsequent first experimentation with cigarettes by follow-up 1 year later.
- This UK study found that e-cigarette use had a greater impact on the odds of cigarette experimentation in young never smokers not traditionally thought to be high risk, that is, those with a firm intention not to smoke and/or no smokers in their friendship group.

coming years. This needs to be set within the context of the rapidly changing landscape of tobacco and nicotine product availability, recent changes in the regulation of advertising and strategies used by industry, particularly the tobacco industry, to promote these products.

Contributors CB conducted the analysis and wrote the first draft of the paper, DC, GO and FH managed the administration of the school survey, data cleaning and analysis and commented on the development of the paper, DE, MS, AMMK, JP, AA, AM and JF were coinvestigators responsible for devising the overall study design and commented on the development of the paper, SH is principal investigator for the DISPLAY study and was involved in devising the overall study, drafting and revising this paper and is its guarantor.

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Competing interests None declared.

Ethics approval University of St Andrews, School of Medicine Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Anonymised data from this study will be made publically available after the end of the study (December 2017). Stata syntax is available from the corresponding author on request.

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E-cigarette users in Europe (including England) are less likely to quit smoking conventional cigarettes: Results challenge PHE recommendation that e-cigarettes be used in hospitals

tobacco.ucsf.edu/e-cigarette-users-europe-including-england-are-less-likely-quit-smoking-conventional-cigarettes-results-challenge-phe-recommendation-e-cigarettes-be-used-hospitals

A new paper based on a large sample of smokers across the European Union, *E-cigarettes Associated with Depressed Smoking Cessation: A Cross-sectional Study of 28 European Union Countries* was just published in the *American Journal of Preventive Medicine*. University of California researchers Margarete Kulik, Nadra Lisha and Stanton Glantz found that in the European Union smokers who use e-cigarettes are less, not more, likely to quit smoking.

An additional analysis pulling out the data from Great Britain alone showed the same thing: smokers who use e-cigarettes are less likely to quit smoking than smokers who do not use e-cigarettes.

This paper is the first large scale study of the relationship between e-cigarette use and quitting smoking compared to people who do not use e-cigarettes in the EU.

The results based on a cross-sectional survey of 12,608 ever smokers conducted by Eurobarometer are consistent with most other studies of real-world e-cigarette use

This new result particularly calls into question recent suggestions from Public Health England that hospitals in Britain begin selling e-cigarettes and provide patients with vaping lounges. The new study suggests that implementing Public Health England's recommendations will keep most people smoking cigarettes. Results from our study strongly indicate that implementing these policies that promote e-cigarette use will substantially worsen the tobacco epidemic.

In a statement we distributed before the paper was published, my co-author Margarete Kulik observed, "We expect a skeptical response from e-cigarette enthusiasts, especially in England" because study is based on cross-sectional data observed at a single point in time. "Cross-sectional data can only be used to measure associations, not causal links," she continued, "but they are a well-established epidemiological method."

It will be interesting to see how vigorously e-cigarette enthusiasts attack our paper based on the dataset we used and the fact that we did a cross-sectional analysis because these same people heralded a paper using the same Eurobarometer data set in a cross-sectional analysis by Farsalinos et al (Electronic cigarette use in the European Union: analysis of a representative sample of 27460 Europeans from 28 countries. *Addiction*. 2016;111(11):2032–2040. https://doi.org/10.1111/add.13506) that concluded that heavier e-cigarette users quit smoking more often than occasional e-cigarette users. (Our analysis found the same thing.) ***The big problem with the Farsalinos et al study was that they left out the control group, smokers who did not use e-cigarettes.***

Our analysis including ***all*** the smokers, including those who did not use e-cigarettes and compares quitting among all three groups. What we find is that heavy e-cigarette users quit smoking more than intermittent e-cigarette uses, ***but both quit less than people smokers who don't use e-cigarettes.***

We certainly hope that the same e-cigarette enthusiasts who touted the earlier paper will accept ours. The data and methods are the same as the earlier study; we just did a more complete analysis.

But, I expect that they will find some way to continue to love the Farsalinos paper while trashing ours. It will be interesting to see how they do it.

In the meantime, one can only hope that the health authorities in Great Britain will abandon their irresponsible and dangerous policies of promoting e-cigarettes for smoking cessation, especially in hospitals and health facilities.

Here is the abstract:

Introduction: Electronic cigarettes (e-cigarettes) are often promoted to assist with cigarette smoking cessation. In 2016–2017, the relationship between e-cigarette use and having stopped smoking among ever (current and former) smokers was assessed in the European Union and Great Britain by itself.

Methods: Cross-sectional logistic regression of the association between being a former smoker and e-cigarette use was applied to the 2014 Eurobarometer survey of 28 European Union countries controlling for demographics.

Results: Among all ever smokers, any regular ever use of nicotine e-cigarettes was associated with lower odds of being a former smoker (unadjusted OR=0.34, 95% CI=0.26, 0.43, AOR=0.43, 95% CI=0.32, 0.58) compared with smokers who had never used e-cigarettes. In unadjusted models, daily use (OR=0.42, 95% CI=0.31, 0.56); occasional use (OR=0.25, 95% CI=0.18, 0.35); and experimentation (OR=0.24, 95% CI=0.19, 0.30) of nicotine e-cigarettes were associated with lower odds of being a former smoker compared with having never used nicotine-containing e-cigarettes. Comparable results were found in adjusted models. Results were similar in Great Britain alone. Among current smokers, daily cigarette consumption was 15.6 cigarettes/day (95% CI=14.5, 16.7) among those who also used e-cigarettes versus 14.4 cigarettes/day (95% CI=13.4, 15.4) for those who did not use them ($p<0.05$).

Conclusions: These results suggest that e-cigarettes are associated with inhibiting rather than assisting in smoking cessation. On the population level, the net effect of the entry of e-cigarettes into the European Union (and Great Britain) is associated with depressed smoking cessation of conventional cigarettes.

The full citation is: Kulik et al. E-cigarettes Associated With Depressed Smoking Cessation: A Cross-sectional Study of 28 European Union Countries. American Journal of Preventive Medicine. Epub ahead of print 12 Feb 2018 DOI: https://doi.org/10.1016/j.amepre.2017.12.017 . It is available here.

Format: Abstract

Send to

Addiction. 2015 Jul;110(7):1160-8. doi: 10.1111/add.12917. Epub 2015 Apr 23.

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

Author information

Abstract

AIMS:

To use a unique longitudinal data set 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 in December 2013.

SETTING:

Great Britain.

PARTICIPANTS:

National general population sample of 4064 adult smokers, with 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 [odds ratio (OR) = 2.11, 95% confidence interval (CI) = 1.24-3.58, P = 0.006], but not with cessation at follow-up (OR = 0.62, 95% CI = 0.28-1.37, 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 = 1.14-5.45, 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.

KEYWORDS:

Electronic cigarettes; electronic nicotine delivery systems; harm reduction; quit attempts; smoking cessation; tobacco

Comment in

Publication type, MeSH terms, Grant support

LinkOut - more resources

Strong evidence for a huge gateway effect for e-cigs in Britain, even stronger than in USA

Strong evidence for a huge gateway effect for e-cigs in England

Recently researchers from England, led by Ann McNeill and including prominent e-cigarette advocates, published a well-done study showing a huge gateway effect for e-cigarettes leading to cigarette smoking among youth in Great Britain.

The paper, "Association between smoking and electronic cigarette use in a cohort of young people," published in *Journal of Adolescent Health*, showed that youth who initiated product use with e-cigarettes had 12 times the odds of smoking cigarettes 4 months later than kids who did not use e-cigarettes.

Two strengths of the study are that it is longitudinal (follows the kids forward in time) and controls for a wide range of other risk factors for smoking, including susceptibility to smoking. The fact that, controlling for susceptibility e-cigarettes have such a huge effect, indicates that (like other studies) e-cigarettes are attracting kids at low risk of initiating nicotine use with conventional cigarettes.

Another impressive thing about the results is that any use of e-cigarettes predicts subsequent any conventional cigarette smoking (even a puff). While this doesn't sound like much, another recent paper led by Peter Hajek, "What Proportion of People Who Try One Cigarette Become Daily Smokers," shows that about two-thirds of kids who take even a puff on a cigarette go on to become daily smokers.

This result shows that the gateway of e-cigarettes in Great Britain is about four times as powerful in Great Britain, where health authorities have embraced e-cigarettes, more than in the US (where most health authorities have been skeptical of e-cigarettes), where the odds of youth who initiate with e-cigarettes progressing to smoking are "only" tripled.

In the press release on the study minimizing its significance that was issued by ASH UK, ASH pointed out that there is a "two-way association" between e-cigarettes and cigarettes (and there is), but the odds of taking up e-cigarettes after cigarettes were increased by 3.5, a much smaller effect. While it is true, the direction is dominantly from e-cigarettes to cigarettes. (This result is similar to a study done at Yale showing that movement from e-cigarettes to cigarettes dominated movement in the opposite direction.)

The authors also tried to minimze the impact of their findings by stating (in the Discussionn section) that "only 4% of never smokers initiated e-cigarette use (vs. 32% of ever smokers) This suggests that e-cigarettes are attracting few who have never smoked." This is misleading because there are a lot more never smokers (81.2% of their sample) than ever smokers (19.8% of their sample). Thus, the prevalence of e-cigarette use generated from never smokers is .04 x .812 = 3.5% and the prevalence of e-cigarette use generated from ever smokers is .32 x .198 = 6.4%. This means that, of all kids using e-cigarettes,

0.35/(0.35+0.64) = 29% were kids who had never smoked a cigarette. This is about the same as the fraction of never-smoking kids who were using e-cigarettes that have been found in the other studies. These kids represent an expansion of the nicotine addiction market.

Here is the abstract:

PURPOSE: Electronic cigarette (e-cigarette) use is associated with smoking initiation among young people; however, it is also possible that smoking is associated with e-cigarette initiation. This study explores these associations among young people in Great Britain.

METHODS: A longitudinal survey of 1,152 11- to 18-year-olds was conducted with baseline in April 2016 and follow-up between August and October 2016. Logistic regression models and causal mediation analyses assessed whether (1) ever e-cigarette use and escalation were associated with smoking initiation (ever smoking at follow-up) among baseline never smokers (n = 923), and (2) ever smoking and escalation were associated with e-cigarette initiation (ever e-cigarette use at follow-up) among baseline never e-cigarette users (n = 1,020).

RESULTS: At baseline, 19.8% were ever smokers and 11.4% were ever e-cigarette users. Respondents who were ever e-cigarette users (vs. never users, 53% vs. 8%, odds ratio [OR] = 11.89, 95% confidence interval [CI] = 3.56-39.72) and escalated their e-cigarette use (vs. did not, 41% vs. 8%, OR = 7.89, 95% CI = 3.06-20.38) were more likely to initiate smoking. Respondents who were ever smokers (vs. never smokers, 32% vs. 4%, OR = 3.54, 95% CI = 1.68-7.45) and escalated their smoking (vs. did not, 34% vs. 6%, OR = 5.79, 95% CI = 2.55-13.15) were more likely to initiate e-cigarette use. There was a direct effect of ever e-cigarette use on smoking initiation (OR = 1.34, 95% CI = 1.05-1.72), and ever smoking on e-cigarette initiation (OR = 1.08, 95% CI = 1.01-1.17); e-cigarette and smoking escalation, respectively, did not mediate these effects.

CONCLUSIONS: Among young people in Great Britain, ever e-cigarette use is associated with smoking initiation, and ever smoking is associated with e-cigarette initiation.

The citation is: East K, Hitchman S, Bakolis I, Williams S, Cheeseman H, Arnott D, McNeill A. Association Between Smoking and Electronic Cigarette Use in a Cohort of Young People. *J Adolesc Health*. 2018 Feb 21. pii: S1054-139X(17)30903-5. doi: 10.1016/j.jadohealth.2017.11.301. [Epub ahead of print]. It is available here.

The best population model to date shows negative overall health impacts of e-cigarettes

Samir Soneji and his colleagues have just published the best-done model for assessing the effects of e-cigarettes on population health so far (including the one Sara Kalkhoran and I published). Their model accounts for the effects of e-cigarette use on youth and young adult initiation as well as cessation in adult smokers. The model is based on extensive population data on smoking behavior and how it evolves over time as well as the health effects of smoking. Most impressively, they use their baseline data to predict future behavior that was subsequently observed and show that the model is accurate. This is the first time anyone has done such a validation, which is a particular strength of the study.

What they find is that ***even making very optimistic assumptions about the effects of e-cigarettes on smoking cessation and assuming a 95% reduction in risk associated with e-cigarette use, the availability of e-cigarettes is associated with net population harm*** (1.5 million years of life lose based on e-cigarette use patterns in 2014)

They found about 8 new smokers for ever one that quit even making the optimistic assumption that smoking cessation increased among e-cigarette users.

More realistic assumptions about the effects of e-cigarettes (that the depress smoking cessation for most smokers and are more than 5% as bad as cigarettes) make the net negative effect even bigger.

Here is the abstract:

BACKGROUND:

Electronic cigarettes (e-cigarettes) may help cigarette smokers quit smoking, yet they may also facilitate cigarette smoking for never-smokers. We quantify the balance of health benefits and harms associated with e-cigarette use at the population level.

METHODS AND FINDINGS:

Monte Carlo stochastic simulation model. Model parameters were drawn from census counts, national health and tobacco use surveys, and published literature. We calculate the expected years of life gained or lost from the impact of e-cigarette use on smoking cessation among current smokers and transition to long-term cigarette smoking among never smokers for the 2014 US population cohort.

RESULTS:

The model estimated that 2,070 additional current cigarette smoking adults aged 25-69 (95% CI: -42,900 to 46,200) would quit smoking in 2015 and remain continually abstinent from smoking for ≥7 years through the use of e-cigarettes in 2014. The model also estimated 168,000 additional never-cigarette smoking adolescents aged 12-17 and young

adults aged 18-29 (95% CI: 114,000 to 229,000), would initiate cigarette smoking in 2015 and eventually become daily cigarette smokers at age 35-39 through the use of e-cigarettes in 2014. Overall, the model estimated that e-cigarette use in 2014 would lead to 1,510,000 years of life lost (95% CI: 920,000 to 2,160,000), assuming an optimistic 95% relative harm reduction of e-cigarette use compared to cigarette smoking. As the relative harm reduction decreased, the model estimated a greater number of years of life lost. For example, the model estimated-1,550,000 years of life lost (95% CI: -2,200,000 to -980,000) assuming an approximately 75% relative harm reduction and -1,600,000 years of life lost (95% CI: -2,290,000 to -1,030,000) assuming an approximately 50% relative harm reduction.

CONCLUSIONS:

Based on the existing scientific evidence related to e-cigarettes and optimistic assumptions about the relative harm of e-cigarette use compared to cigarette smoking, e-cigarette use currently represents more population-level harm than benefit. Effective national, state, and local efforts are needed to reduce e-cigarette use among youth and young adults if e-cigarettes are to confer a net population-level benefit in the future.

The full citation is Soneji SS, Sung HY, Primack BA, Pierce JP, Sargent JD. Quantifying population-level health benefits and harms of e-cigarette use in the United States. PLoS One. 2018 Mar 14;13(3):e0193328. doi: 10.1371/journal.pone.0193328. eCollection 2018. It is available for free here.

Good news for Big Tobacco: E-cigs are a strong gateway for young adults to start smoking cigarettes

It is almost an article of faith in tobacco control that about 90 of adult smokers smoke their first cigarette before age 18 and that virtually no one starts smoking after age 26. That is likely why all the studies on the ***gateway effect*** of e-cigarettes leading to smoking have been done with youth, where the evidence is strong and consistent.

Now a troubling new study shows that e-cigarettes have changed that.

Brian Primack and colleagues recently published "Initiation of Traditional Cigarette Smoking after Electronic Cigarette Use among Tobacco-Naïve U.S. Young Adults" that shows that the odds of never-smoking young adults (***age 18-30***) who use e-cigarettes having started to smoke cigarettes 18 months later at ***6.8 times higher*** than young adults who don't use e-cigarettes even after adjusting for a wide range of other factors that predict smoking.

This is a stunning result. They found that 47.7% of never-smoking young adults who used e-cigarettes at baseline were smoking cigarettes a year later compared to just 10.2% of non-users.

While they did not explore why this happens in their survey, they make a pretty plausible argument in the Discussion section of their paper:

> It may seem unlikely that e-cigarette users may transition from a flavored, highly palatable device such as an e-cigarette to a more noxious, unflavored cigarette. However, there are several reasons why individuals who try e-cigarettes may be at risk for this transition, even if they do not intend on smoking cigarettes at first. One reason is that many e-cigarettes—particularly early-generation devices—provide nicotine more slowly than traditional cigarettes. Thus, they may serve as an ideal transition vehicle, allowing a new user to advance to cigarette smoking as tolerance to side effects develops. Just as new cigarette users begin to report craving for nicotine within weeks of their first cigarette, initial e-cigarette users may soon begin to seek out cigarettes as a more efficient nicotine delivery device. E-cigarettes also mimic many powerful behavioral cues of cigarette smoking, including inhalation, exhalation, and holding the implement. For example, people exposed to e-cigarette advertising report more craving for smoking cigarettes. Initial exposure to nicotine in other forms—such as smokeless tobacco—can lead to later traditional cigarette smoking. Thus, one might expect susceptibility to be even greater when the presence of nicotine is augmented by strong behavioral cues of cigarette smoking. Finally, initial e-cigarette users also may transition to traditional cigarettes because of changing social pressures over time. For example, while most initial alcohol users favor sweet, sugary beverages, many ultimately transition to harsher and more concentrated forms. Future qualitative research among e-cigarette users may be particularly valuable for identifying whether this situation may be somewhat analogous for the transition from e-cigarettes to cigarettes. [citations removed]

This is all bad news for public health and great news for the cigarette companies that are increasingly dominating the e-cigarette market. The tobacco companies have worked for decades to crack the young adult market and e-cigarettes are the path.

Here is the abstract:

Background. While electronic cigarettes (e-cigarettes) may help some smokers quit, some young adult never-smokers are now using e-cigarettes recreationally, potentially increasing their risk for initiation of smoking. We aimed to determine the association between baseline e-cigarette use and subsequent initiation of cigarette smoking among initially never-smoking young adults.

Methods. We conducted a prospective cohort study with assessments at baseline (March 2013) and follow-up (October 2014). We used sampling frames representing 97% of the U.S. population to recruit a nationally-representative sample of never-smoking young adults ages 18-30. The independent variable was baseline ever use of e-cigarettes. The main outcome measure was initiation of traditional cigarette smoking between baseline and 18-month follow-up.

Results. Baseline surveys were completed by 1506 never-smoking young adults, of whom 915 (60.8%) completed follow-up. There were no demographic differences between responders and non-responders. After applying survey weights—which accounted for both non-response and over or under coverage—2.5% of the represented population of never-smokers (801,010 of 32,040,393) used e-cigarettes at baseline. Cigarette smoking was initiated by 47.7% of e-cigarette users and 10.2% of non-users (P=.001). In fully-adjusted multivariable models, e-cigarette use at baseline was independently associated with initiation of smoking at 18 months (adjusted odds ratio=6.8, 95% confidence interval=1.7–28.3). Results remained similar in magnitude and statistically significant in all sensitivity analyses.

Conclusions. Baseline e-cigarette use was independently associated with initiation of traditional cigarette smoking at 18 months. This finding supports policy and educational interventions designed to decrease use of e-cigarettes among non-smokers.

The full citation is Primack B, et al. Initiation of Traditional Cigarette Smoking after Electronic Cigarette Use among Tobacco-Naïve U.S. Young Adults. *Am J Med.* 2017 Nov 17. pii: S0002-9343(17)31185-3. doi: 10.1016/j.amjmed.2017.11.005. [Epub ahead of print]

The paper is available here.

Another longitudinal study shows that kids at low risk of smoking who use e-cigs are a lot more likely to progress to cigarettes

September 8, 2015

Stanton A. Glantz, PhD

Brian Primack and his colleagues just published the second longitudinal study demonstrating that adolescents who use e-cigarettes are much more likely to progress to smoking cigarettes than adolescents who do not use e-cigarettes.

Their paper, "Progression to Traditional Cigarette Smoking After Electronic Cigarette Use Among US Adolescents and Young Adults," published in *JAMA Pediatrics*, is especially strong because it is a national study of youth who were at low risk of smoking (called susceptibility) at the beginning of the study when they assessed e-cigarette use.

What they found was that the kids who used e-cigarettes were **8.3 times more likely to be actuall smoking cigarettes a year later**.

In addition, among those kids who had not yet started smoking a year later, they were 8.5 times more likely to be susceptible to future smoking. In other words, the use of e-cigarettes moved them along to behavioral continuum towards smoking during the year.

The results in this study are consistent with the longitudinal study of Southern California youth published by Leventhal and colleagues at USC a couple weeks ago as well as our earlier cross-sectional studies and other papers demonstrating that many kids at low risk of smoking cigarettes were initiating nicotine addiction with e-cigarettes.

An accompanying editorial by Jon Klein calls on the FDA (really the Obama Administration) to get off its duff and start regulating e-cigarettes. (We had been told by FDA officials to expect the "deeming" rule in June, now 3 months ago.) The reality is, however, that the FDA's proposed rule would simply assert jurisdiction over e-cigarettes and would not impose any meaningful controls on kid-attracting flavors (which were explicitly left out of the draft rule) or marketing. Even, if by some miracle, the White House were to allow the FDA

to take meaningful action it would be tied up in court anyway.

So, as always, the responsibility to deal with e-cigarettes will remain with local and state governments to include e-cigarettes in clean indoor air laws, educational campaigns, and tax them at levels that will discourage use.

The full paper is here and Klein's commentary is here.