Risk of adolescent cigarette use in three UK birth cohorts before and after e-cigarettes

Jessica M Mongilio ,[1] Jeremy Staff,[2] Christopher H Seto,[3] Jennifer L Maggs,[4] Rebecca J Evans-Polce[1]

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[1]Center for the Study of Drugs, Alcohol, Smoking and Health, Department of Health Behavior and Clinical Sciences, University of Michigan, Ann Arbor, Michigan, USA
[2]Department of Sociology, Pennsylvania State University, University Park, Pennsylvania, USA
[3]Department of Sociology, Purdue University, West Lafayette, Indiana, USA
[4]Department of Human Development and Family Studies, Penn State University, University Park, Pennsylvania, USA

Correspondence to
Dr Jessica M Mongilio; jemongi@umich.edu

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ABSTRACT

Objective Longitudinal data from three UK birth cohorts (born in 1958, 1970 and 2001) were used to (1) document the historic decline in adolescent cigarette smoking; (2) examine how e-cigarette use is associated with adolescent cigarette smoking in the most recent cohort; and (3) compare probabilities of cigarette smoking across the cohorts.

Methods The prevalence of adolescent cigarette smoking was assessed in 1974 from 11 969 youth in the National Child Development Study (NCDS), in 1986 from 6222 youth in the British Cohort Study (BCS), and in 2018 from 9733 youth in the Millennium Cohort Study (MCS). Logistic regression models were used to estimate the odds of adolescent smoking (ages 16–17) based on a common set of childhood risk and protective factors; adolescent e-cigarette use was included as a predictor in the more recent MCS.

Results Adolescent cigarette smoking declined from 33% in 1974 to 25% in 1986 and to 12% in 2018. 11% of MCS youth reported current e-cigarette use. Though childhood risk factors for later adolescent smoking were mostly similar across the three cohorts, the risk of cigarette smoking in the MCS varied greatly by e-cigarette use. Among MCS youth, the average predicted probability of smoking ranged from 1% among e-cigarette naïve youth to 33% among youth currently using e-cigarettes.

Conclusions Adolescents who use e-cigarettes have a similar smoking prevalence to earlier generations. Policy and prevention should seek to prevent adolescent nicotine exposure via both electronic and combustible cigarettes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The prevalence of tobacco cigarette smoking has declined over the past 25 years.
⇒ E-cigarette use in adolescence is associated with greater risk of tobacco cigarette smoking and dual use (ie, e-cigarette use and cigarette smoking).

WHAT THIS STUDY ADDS

⇒ In three nationally representative UK birth cohorts, adolescent cigarette smoking declined from 33% in 1974 to 25% in 1986 and to 12% in 2018.
⇒ Contemporary youth who used e-cigarettes had a similar probability of smoking cigarettes to youth observed five decades earlier.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Many risk factors for youth smoking were similar across the cohorts.
⇒ Tobacco control efforts should continue to focus on the prevention of general youth nicotine use and to specifically target youth who use e-cigarettes because their risk of cigarette smoking is similar to youth in the 1970s.

INTRODUCTION

Research shows significant historical declines in the prevalence of adolescents who smoke cigarettes, partly because of successful tobacco control efforts as well as broad shifts in key intergenerational risk factors for adolescent smoking, such as increases in parental education and reductions in the proportion of teenagers whose parents smoke.[1–8] The recent increase in electronic cigarette ('e-cigarette') use among youth[6 9–13] may have disrupted these historic declines in youth tobacco smoking as research shows that adolescent e-cigarette use increases the risk of later tobacco cigarette smoking and dual use.[13–20] Previous work using interrupted time series analyses to assess whether e-cigarette use has coincided with a slowing of historic declines in youth cigarette smoking is equivocal. Some researchers have found evidence of a significant slowing in the rate of decline of youth smoking as a byproduct of e-cigarette popularisation,[21 22] while others do not find evidence of any meaningful change.[23 24] If historic declines are slowing, it is unclear how the risk of cigarette smoking among contemporary youth—and especially among youth who use e-cigarettes—compares to youth from previous generations who came of age before notable tobacco control efforts and before the market introduction of e-cigarettes.

To address this gap, we used intergenerational, longitudinal data from three birth cohorts of UK youth (born in 1958, 1970 and 2001). Each of these nationally representative cohorts developed in distinct historic periods spanning a dramatic time of change in the smoking and nicotine landscapes. The Millennium Cohort Study (MCS) follows a more contemporary cohort of youth who were born in 2000–2001 and who were children when e-cigarettes were introduced. The British Cohort Study (BCS) follows children born a generation earlier in 1970 who were teenagers in the 1980s when cigarette use among youth was relatively widespread, and who were in their 40s before e-cigarettes were introduced. The National Child Development Study (NCDS) follows children born in 1958 who

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were teenagers in the mid-1970s and were children when cigarette consumption was at its historic peak.

In a series of logistic regressions for each cohort, we used prospective data to adjust for a common set of risk and protective factors for adolescent smoking drawn from parental and cohort member assessments from infancy, childhood and adolescence. Our focal outcome, adolescent cigarette smoking, was assessed by adolescent self-reports at ages 16 (BCS, NCDS) or 17 (MCS). Adolescent e-cigarette use in the MCS was self-reported at age 17. Our use of the three UK birth cohorts allows us to: (1) document the historic decline in adolescent cigarette smoking; (2) examine associations of e-cigarette use with adolescent smoking among contemporary youth; and (3) compare estimated probabilities of cigarette smoking for contemporary youth who do and do not report e-cigarette use with those of previous generations.

METHODS

Data

The analytic samples were derived from three ongoing, national, longitudinal cohort studies in the UK. The MCS sampled 9-month-old infants born in the UK between September 2000 and January 2002.[25 26] The BCS sampled all youth living in the UK born in one week in April 1970,[27–29] and the NCDS focused on all youth living in the UK who were born in one week in March 1958.[27 30 31] At their baseline surveys, 18 552 infants participated in the MCS (91% of targeted sample), 16 571 infants in the BCS (96% of births), and 17 415 infants in the NCDS (99% of births). Multi-informant data from cohort members, as well as parents, caregivers and other family members, were collected longitudinally in all three studies. In addition to baseline surveys at either birth (BCS, NCDS) or 9 months (MCS), MCS cohort members provided data at ages 3, 5, 7, 11, 14, 17 and 23 years of age; BCS respondents at ages 5, 10, 16, 26, 30, 34, 38, 42, 46 and 51 years of age; and NCDS respondents at ages 7, 11, 16, 23, 33, 42, 46, 50, 55 and 62 years of age. We focus on childhood antecedent data and nicotine use through age 16 or 17. The study was deemed exempt from IRB review by the first author's institution.

To facilitate comparison across cohorts, we replicated measurement coding schemes as closely as possible and drew from waves when cohort members were similar in age. For instance, each analytic sample was composed of cohort members who indicated whether they were currently smoking at age 16 in the BCS and NCDS and age 17 in the MCS. Child and parent-level risk and protective factors were drawn from the birth and age 7, 11 and 16 waves in the NCDS; birth and age 5, 10 and 16 waves in the BCS; and 9-month and age 5, 11, 14 and 17 waves in the MCS. These criteria yielded 11 969 respondents in the NCDS, 6222 in the BCS and 9733 in the MCS. The BCS experienced a high amount of missing data due to a teachers' strike during the age 16 data collection, leading to a smaller than expected sample size; however, it is unlikely that this external event biased estimates.[32]

Measures

Outcome: Adolescent cigarette smoking

When youth were age 16 in the NCDS and BCS and age 17 in the MCS, they reported whether or how often they were currently smoking cigarettes. To maximise consistency across cohorts, cigarette smoking was coded '1' if the youth reported currently smoking at least one cigarette in a typical week and '0' if they did not meet this threshold.

E-cigarette use among MCS youth

At age 17, youth in the MCS cohort reported on their use of e-cigarettes or vaping devices. Responses to this measure were categorised into three groups: never use, past or experimental use (eg, tried once and then never again) or current use (ie, within the past month).

Risk and protective factors

In all three cohorts, we included controls for a variety of child-level and parent-level risk and protective factors of adolescent cigarette smoking. Child-level factors include whether they had *ever drunk alcohol* by age 16 or 17, and their *school engagement* at age 16 (NCDS, BCS) and 14 (MCS). We constructed mean scales for each cohort based on five consistent items asked of each cohort (eg, 'how much do you like school?'), with higher scores indicating higher investment in education. The scales were then standardised (mean=0, SD=1) within cohort for ease of comparison (Cronbach's α ranged from 0.71 to 0.77). Adolescents also completed investigator-assessed tests of *verbal ability* at ages 10 (NCDS, BCS) or 11 (MCS). Full descriptions can be found at https://cls.ucl.ac.uk/cls-studies/. All tests contained age-appropriate questions regarding vocabulary and comprehension. Scores were standardised within cohorts, with higher scores indicating higher verbal ability. Finally, *externalising behaviours* were reported by the mother or main caregiver at ages 10 or 11. The Strengths and Difficulties Questionnaire[33] from the MCS was used as a reference for the items of interest within the other surveys. Only items that were consistent across all surveys were used, including the child being 'squirmy or fidgety', '(dis)obedient', 'restless', 'quick-tempered' and whether they 'fight with other children'. Five items were averaged to construct scales measuring externalising behaviours (Cronbach's α 0.63–0.78) and standardised within cohort, with higher scores indicating more externalising behaviour.

In addition to child-level factors, we included controls for intergenerational risk and protective factors, including parental occupation, education and smoking behaviour.[34–36] In the NCDS and BCS, mothers were not asked their occupational class, and so we relied on father's *occupational status*. This measure was coded into three categories (father unemployed or not present; manual/routine to small employer/self-employed; intermediate, managerial or professional), using the most recent report from the child's father and using reports from mothers where fathers had missing data in the MCS. We also included a measure of what age the child's *mother left full-time education* (coded continuously in years). In addition, we include measures indicating whether the respondent's mother *smoked during pregnancy* (coded as never smoked during pregnancy; stopped smoking during pregnancy; and never stopped smoking or initiated smoking during pregnancy). Finally, *parental tobacco use* when cohort members were age 16 in the NCDS and BCS and age 14 in the MCS was included in analytic models. Parental tobacco use was not assessed at age 17 in the MCS. This measure was dichotomised as tobacco use by at least one parent in the household (eg, cigarettes, cigars, pipes and chewing tobacco) versus no parental tobacco use.

In all analytic models, we included controls for cohort member sex (male=1), race and a continuous measure of age. Our measure of race was dichotomised as white (=1) versus non-white because the NCDS and BCS samples are overwhelmingly composed of white youth (98% and 95%, respectively) and did not allow for further differentiation.

Analytic plan

The MCS provided survey weights to adjust for the study's complex sampling design (ie, strategic oversampling of racial minority children, as well as children from economically disadvantaged areas) and respondent attrition. Since the NCDS and BCS cohorts were not based on a complex survey design, we constructed survey weights based on the inverse probability of age 16 attrition as predicted by sex, ethnicity and country of birth. All analyses account for the relevant weights for each cohort. For all three cohorts, we then used multiple imputation with chained regressions, which reduces bias from item missingness when data are missing at random,[37] using the 'mi estimate' command in Stata 18.0[38] to produce 25 imputed datasets. Covariates of interest for the analytic models were used in the imputation procedure, which, in combination with survey weights to account for non-response, should reduce bias that may arise from multiple imputation when data are not missing at random.

Weighted logistic regression models predicting adolescent cigarette smoking were estimated using the imputed data for each cohort, controlling for the common set of predictors. E-cigarette use was included as a predictor of youth smoking in only the MCS analytic sample. We note that the associations of covariates with cigarette smoking across cohorts should be interpreted with caution, given that estimates are conditional on the other variables included in the model and that correlations between covariates may vary by cohort.[39]

After model estimation, predicted probabilities were derived from the 'mimrgns' command.[40] For the MCS cohort, these probabilities were estimated for those who had never used e-cigarettes, those who had previously tried e-cigarettes, and those who currently used e-cigarettes to assess whether the predicted probability of cigarette smoking varies by e-cigarette use in the MCS cohort. All other covariates were held at the sample means. For the NCDS and BCS cohorts, predicted probabilities were derived when all covariates were held at their sample means.

RESULTS

Table 1 presents the weighted descriptive statistics for the three cohorts and shows a steep decline in adolescent cigarette smoking, with current smoking dropping from 33% in 1974 (NCDS) to 25% in 1986 (BCS) and to 12% in 2018 (MCS). Approximately half of the MCS cohort had not used e-cigarettes by age 17, while 41% had previously used and 11% reported current e-cigarette use.

The descriptive statistics in table 1 also show trends in child-level and parent-level risk and protective factors for adolescent cigarette use. For instance, the percentage of youth who had consumed alcohol by age 16 or 17 decreased across the cohorts, from 94% in the NCDS cohort to 83% in the MCS cohort. At the parent level, the average age at which mothers left education increased over time, from 15.5 years in the NCDS to 17.7 years in the MCS. The prevalence of parental tobacco use decreased over time, from over 70% in the NCDS cohort to 27% in the MCS cohort, and fewer mothers had continued smoking during their pregnancy in the MCS cohort than in previous cohorts.

Table 1 Weighted descriptive statistics and percent imputed by cohort

	NCDS (N=11 969)			BCS (N=6222)			MCS (N=9733)		
	Mean or %	SE	% Imputed	Mean or %	SE	% Imputed	Mean or %	SE	% Imputed
Focal outcome									
Weekly cigarette smoking	33%		0%	25%		0%	12%		0%
Child predictors									
E-cigarette use	N/A			N/A					<1%
Never used							48%		
Past or experimental use							41%		
Current use							11%		
Ever drank alcohol	94%		<1%	91%		1%	83%		<1%
Externalising behaviour (std)	−0.02	0.010	15%	−0.11	0.013	11%	0.27	0.029	0%
School engagement (std)	0.00	0.009	<1%	0.01	0.013	3%	−0.02	0.026	6%
Verbal ability (std)	0.05	0.010	14%	0.17	0.013	6%	0.03	0.031	6%
Age (years)	16.0	0.001	<1%	16.5	0.006	4%	17.2	0.007	0%
White	98%		0%	95%		2%	87%		0%
Male	51%		0%	44%		0%	50%		0%
Parental predictors									
Father's occupational status			1%			2%			5%
Unemployed or absent	<1%			<1%			7%		
Manual, routine or self-employed	75%			64%			45%		
Intermediate, managerial or professional	25%			35%			47%		
Age mother left education	15.5	0.015	19%	16.1	0.036	25%	17.7	0.081	5%
Mother's smoking during pregnancy			6%			8%			4%
Never smoked	60%			59%			66%		
Quit smoking	8%			5%			14%		
Did not quit smoking	33%			36%			21%		
Parent(s) tobacco use	72%		20%	49%		20%	27%		7%

Weighted descriptive statistics based on 25 imputed datasets; some predictors do not sum to 100% due to rounding.
BCS, British Cohort Study; MCS, Millennium Cohort Study; NCDS, National Child Development Study; std, standardised means before imputation.

Table 2 ORs and 95% CIs from multivariable logistic regressions predicting weekly cigarette smoking at age 16 or 17 in the NCDS, BCS and MCS based on child and parental risk and protective factors

	NCDS (n=11 969)		BCS (n=6222)		MCS (n=9733)	
	OR	95% CI	OR	95% CI	OR	95% CI
Child predictors						
E-cigarette use (age 17)						
Never used					0.10***	(0.07 to 0.14)
Past or experimental use					Reference category	
Currently use					3.34***	(2.61 to 4.27)
Ever drank alcohol (age 17)	2.87***	(2.32 to 3.56)	4.37***	(3.00 to 6.36)	3.15***	(1.86 to 5.35)
Externalising behaviour (std)	1.17***	(1.12 to 1.23)	1.21***	(1.12 to 1.30)	1.34*	(1.06 to 1.68)
School engagement (std)	0.51***	(0.49 to 0.53)	0.53***	(0.50 to 0.57)	0.75**	(0.63 to 0.88)
Verbal ability (std)	0.94*	(0.90 to 0.99)	0.92**	(0.86 to 0.98)	0.92	(0.78 to 1.09)
Age (years)	1.07	(0.74 to 1.56)	1.07	(0.93 to 1.24)	1.37	(0.99 to 1.91)
White	1.41*	(1.05 to 1.88)	1.69*	(1.12 to 2.55)	0.90	(0.42 to 1.90)
Male	1.07	(0.98 to 1.16)	0.66***	(0.58 to 0.76)	0.79	(0.61 to 1.01)
Parental predictors						
Father's occupational status						
Unemployed or absent	1.44	(0.65 to 3.16)	1.94*	(1.05 to 3.57)	1.19	(0.66 to 2.15)
Manual, routine or self-employed	Reference category		Reference category		Reference category	
Intermediate, managerial or professional	0.86**	(0.77 to 0.96)	1.07	(0.92 to 1.23)	0.99	(0.67 to 1.48)
Age mother left education	1.00	(0.97 to 1.04)	1.02	(0.99 to 1.05)	0.94	(0.88 to 1.00)
Mother's smoking during pregnancy						
Never smoked	Reference category		Reference category		Reference category	
Quit smoking	1.00	(0.85 to 1.17)	1.03	(0.75 to 1.40)	1.65**	(1.17 to 2.32)
Did not quit smoking	0.99	(0.90 to 1.09)	1.10	(0.95 to 1.28)	2.04**	(1.33 to 3.13)
Parent(s) tobacco use	1.44***	(1.28 to 1.62)	1.46***	(1.25 to 1.70)	1.11	(0.77 to 1.59)

Results based on 25 imputed datasets.
*p<0.01; **p<0.05; ***p<0.001.
BCS, British Cohort Study; MCS, Millennium Cohort Study; NCDS, National Child Development Study; std, standardised means before imputation.

Table 2 displays ORs and 95% CIs from multivariable logistic regressions predicting cigarette smoking once a week or more at age 16 or 17 for each of the three cohorts. Many risk factors show similar magnitudes of associations with cigarette smoking across cohorts, conditional on the other included covariates. For instance, the odds of smoking were 2.87 times higher for NCDS youth who had drunk alcohol (95% CI 2.32 to 3.56), 4.37 times higher for BCS youth who had drunk (95% CI 3.00 to 6.36) and 3.15 times higher for MCS youth who had drunk (95% CI 1.86 to 5.35), controlling for all other model predictors. In all three cohorts, greater externalising behaviour was associated with greater odds of smoking (OR ranging from 1.17 to 1.34), net of other risk and protective factors. In addition, school engagement and verbal ability scores were negatively associated with cigarette smoking at age 16 or 17 in all three cohorts.

The conditional associations of the parent-level risk and protective factors with youth smoking were less consistent across the three cohorts. For instance, parental tobacco use was a risk factor for adolescent cigarette smoking in NCDS and BCS, whereas maternal smoking during pregnancy was a risk factor for youth cigarette smoking in the MCS. Controlling for all other risk and protective factors included in the model, youth whose parents were in higher status jobs were less likely to smoke, but only in the NCDS cohort. The results also show some demographic variation in smoking behaviour across the cohorts. White youth had higher odds of cigarette smoking in the NCDS and BCS, but not in the MCS cohort, net of other covariates. Girls were also less likely than boys to smoke in the BCS only.

In the MCS, at age 17, compared with those who reported past or experimental e-cigarette use, those reporting current e-cigarette use had 3.34 times greater odds of smoking cigarettes at least once a week (95% CI 2.61 to 4.27), net of all other risk and protective factors included in the model. In contrast, youth who had never used e-cigarettes had 0.10 lower odds (95% CI 0.07 to 0.14), or a 90% decrease in the likelihood of smoking, compared with those who reported past or experimental use of e-cigarettes.

To illustrate how the likelihood of cigarette smoking varies for an 'average' youth across the three cohorts, we derived predicted probabilities of cigarette smoking based on the models shown in table 2, with all risk factors included in the models held at their cohort-specific means. Figure 1 shows these predicted probabilities for youth in the NCDS and BCS and then further stratifies MCS youth by their e-cigarette use. The presented predicted probabilities indicate the likelihood that a youth with average levels of the risk factors within each cohort—or within each category of e-cigarette use in the MCS—would report cigarette smoking at age 16 or 17.

'Average' youth in the NCDS and BCS cohorts had a 30% and 22% predicted probability of cigarette smoking, respectively. Within the MCS cohort, the predicted probability of cigarette smoking among 'average' youth who had never used e-cigarettes was 1.4% (95% CI 0.8 to 1.9). For the 11% of MCS youth who reported current e-cigarette use, the predicted probability of cigarette smoking was 32.6% (95% CI 28.2 to 37.1), which was similar to or higher than the estimated predicted probability of cigarette smoking for youth in the BCS and NCDS cohorts.

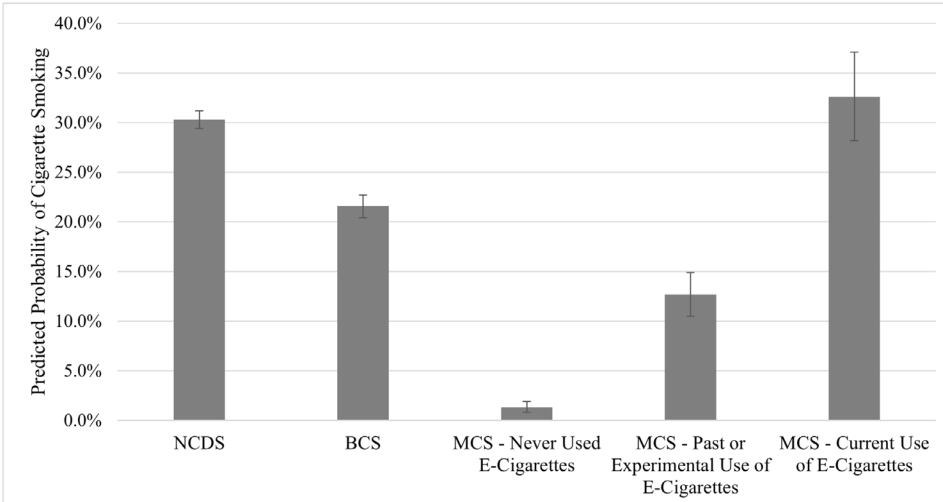

Figure 1 Average predicted probabilities of cigarette smoking at age 16 or 17 for the three cohorts and separated by e-cigarette use in the MCS.

Estimates for MCS youth who reported past or experimental use of e-cigarettes fell in between these two groups, with a predicted probability of cigarette smoking of 12.7% (95% CI 10.5 to 14.9).

Supplementary analyses

Multivariable logistic regressions were estimated for each cohort, using only complete cases (ie, not imputed data). Our findings are robust to this model specification (online supplemental table A), and the predicted probabilities of cigarette smoking generated from these models are substantively identical to those of the imputed samples (online supplemental figure A). Additionally, a multivariable logistic regression was estimated for the MCS cohort without the e-cigarette use covariate to compare point estimates to those of the NCDS and BCS cohorts. Although not directly comparable to the model with the inclusion of the e-cigarette use covariate because of the re-scaling that occurs with logistic regression,[41] point estimates for the other risk and protective factors of interest are similar across model specifications (online supplemental table B).

DISCUSSION

During the late 20th century, we achieved great success in reducing cigarette smoking among youth, with prevalence rates falling dramatically during the 21st century.[1 2 4] Consistent with these trends, we show that the proportion of youth who were currently smoking dropped from 33% in 1974 (NCDS) to 25% in 1986 (BCS), and then to 12% in 2018 (MCS). Part of this success is likely because of tobacco control efforts. For instance, the minimum legal age for purchasing cigarettes in the UK rose from 16 to 18 in 2007, meaning that youth in the NCDS and BCS samples would have been able to obtain cigarettes legally, while the majority of MCS respondents would not have had such easy access to cigarettes. Additionally, public understanding of the health consequences of cigarette smoking has developed over this time, and social norms about smoking have become much more negative.[42 43]

However, the anticipated reduction in the risk of cigarette smoking was not uniform for all youth in the MCS cohort born in 2000–2001. In this group, the probability of smoking was close to zero among those who had never used e-cigarettes. Yet, those who reported current use of e-cigarettes had a probability of smoking that was, in fact, slightly *higher* than that of youth born over 40 years earlier in 1958. This probability is especially concerning given the recent increases in e-cigarette use prevalence among UK youth,[4] despite some initial assurances that e-cigarettes would have little appeal to youth.[1 6 9 13] Furthermore, our findings suggest that the success of previous tobacco control efforts and broad shifts in intergenerational risk factors in reducing risk of cigarette smoking may be mitigated when adolescents use e-cigarettes.[44]

In our analysis of data from three UK cohort studies to explore risk factors for cigarette smoking among youth in the 1970s and 1980s, relative to those who were teenagers after the introduction of e-cigarettes, we found that many child-level and parent-level risk and protective factors functioned similarly across these cohorts. For instance, alcohol use, poor school engagement and externalising behaviours were all robust predictors of teenage smoking. Given that the MCS youth overall had fewer risk factors for smoking, including being less likely to have ever drunk alcohol (83% vs 94% in the NCDS cohort) and having parents who were more educated and less likely to smoke, the high probability of cigarette smoking among MCS youth who were using e-cigarettes is even more striking. Indeed, it may be that youth who would have historically been considered ‘low risk’ of combustible cigarette use become ‘at risk’ through their nicotine exposure by experimenting with or using e-cigarettes.

The breadth of data available across these three birth cohorts and their consistency across time is a great strength of this paper, allowing us to delineate changes in the landscape of cigarette smoking over several decades. However, despite our efforts to maximise consistency across these cohorts and the included covariates, there may be some lingering differences in measurement that could affect point estimates. For instance, potential changes in the interaction or correlation of covariates over time would affect our ability to directly compare the strength of risk and protective factors between cohorts.[39] Additionally, we are unable to account for some sociodemographic characteristics, including additional racial and ethnic groups, due to insufficient sample sizes in the earlier cohorts. Within the MCS cohort, estimates of the associations between e-cigarette use and cigarette smoking are not causal and should not be interpreted as such, especially as temporal ordering of cigarette and e-cigarette initiation is not explicitly established. Even with these considerations, the present study provides important information regarding historical trends in the likelihood of cigarette smoking among youth, especially for contemporary youth who use e-cigarettes.

As cigarette smoking remains the leading cause of preventable illness,[4] it is crucial to understand how e-cigarette use in adolescence is associated with later cigarette smoking and dual use. While our research shows that the historic decline in the likelihood of youth cigarette smoking has continued in this recent cohort of UK youth overall, we find that this is not the case among e-cigarette users. Youth who had never used e-cigarettes had an estimated less than 1 in 50 chance of reporting weekly cigarette use at age 17, while those who had previously used e-cigarettes had over a 1 in 10 chance. Youth who reported current e-cigarette use had an almost 1 in 3 chance of also reporting current cigarette use. As such, the decline in the likelihood of cigarette smoking is waning for youth who have used e-cigarettes—about half of our sample—and has reversed for those currently using e-cigarettes. Among contemporary youth, efforts to reduce cigarette smoking should focus both on those who are currently using e-cigarettes and on the prevention of e-cigarette use among youth to maintain the promising declines in youth nicotine use in years to come.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants but University of Michigan IRB exempted this study. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data are available upon reasonable request through the CLS (https://cls.ucl.ac.uk/cls-studies/) and the UK Data Archive (https://beta.ukdataservice.ac.uk/datacatalogue/series/). Data used for these analyses are available to scholars by request from the organisation that oversees the NCDS, BCS and MCS surveys.

ORCID iD
Jessica M Mongilio http://orcid.org/0000-0003-0649-8404

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