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Investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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Abstract

Objectives: This study presents a prospective evaluation of the effect of 2012 point-of-sale (PoS) display ban in large shops in England on perceived exposure to PoS displays, and on changes in susceptibility and smoking uptake among young people.

Design: Cohort study

Settings: Seven schools in Nottinghamshire, England

Participants: 1,844 11-16 year-old schoolchildren

Primary and secondary outcome measures: Changes in reported exposure to PoS displays before and after prohibition, and the association between exposure to and awareness of PoS displays and change in susceptibility to smoking and smoking status between 2012 and 2013

Results: The proportion of children noticing tobacco PoS displays in supermarkets most or every time they visited a shop after the ban decreased by about 11 percentage points, from 57.9% in 2012 to 46.9% in 2013. However, although more frequent exposure to PoS displays, and recognition of a higher number of tobacco brands, were both associated with a higher likelihood of development of smoking susceptibility or of smoking uptake, these associations were not independently significant.

Conclusions: Prohibition of PoS in large supermarkets resulted in a small decline in the proportion of young people noticing PoS displays in large shops, and little or no change in smoking uptake or susceptibility. It remains to be seen whether extension of the PoS ban to all shops in 2015 has a more marked effect.

Strengths and limitations of this study:

- This is the first individually linked cohort study investigating changes in exposure to and awareness of tobacco point-of-sale (PoS) displays, and changes in susceptibility to smoking and smoking uptake in relation to first stage of tobacco point-of-sale display ban in England.
- Data were collected using self-administered questionnaires including a wide range of variables: socio-demographic factors, smoking among peers and family, self-perceived academic performance and rebelliousness, smoking status and susceptibility to smoking, exposure to and awareness of tobacco PoS displays, and number of tobacco brands recognised.
- Our findings are limited by low power arising from the relatively small number of participants for whom linked data could be identified, and the fact that changes were investigated one year after the implementation of the ban though longer follow-up time might be required to observe considerable changes in susceptibility as a result of reduced exposure and awareness.

Introduction

Smoking is the largest avoidable cause of death in the UK [1]. Although the prevalence of smoking among adults in Great Britain has declined substantially over recent decades [2] there are still about 9 million smokers in the UK [3], most of whom became smokers before the age of 18 [4]. Although smoking prevalence among young people in Britain has also declined, reaching 8% among 15 year olds in England in 2014, around 207,000 children start smoking every year in the UK [4]. Therefore policies to prevent smoking uptake among young people are of crucial public health importance.

Smoking prevalence has declined in the UK as a result of comprehensive tobacco control policies including legislation prohibiting most forms of tobacco advertising [5]. However until recently in the UK, this legislation provided an exemption for tobacco product displays at the point of sale (PoS). Previous studies have suggested that being exposed to tobacco PoS displays causes adults who intend to quit to make unplanned tobacco purchases [6], and that removal of PoS displays reduces these impulse purchases [7]. Findings from the International Tobacco Control Four Country Survey support these findings, suggesting that PoS display bans reduce exposure to tobacco marketing and the frequency of unplanned purchases of tobacco products [8]. Although there is less evidence on the effect of PoS displays on youth smoking behaviour, we have recently reported data from England suggesting that children with higher levels of exposure to tobacco PoS displays are more likely to be susceptible to smoking [9], and that noticing PoS displays more often was a prospective determinant of the onset of susceptibility [10]. Being susceptible to smoking is associated with an increased risk of experimentation with smoking, and smoking uptake, among adolescents [11].

In England in April 2012 tobacco PoS displays were banned in all large shops, defined as those with a floor area over 280 square meters [12] and in almost all cases supermarkets. We now report an extension to our earlier work [9][10] investigating whether this measure has reduced exposure to and awareness of tobacco at PoS among young people, or altered the previously observed relation between exposure to PoS displays and becoming susceptible to smoking or smoking uptake.

Methods

Data collection

Between March and May 2013 we carried out the third in a series of cross-sectional surveys of smoking behaviour, exposure to and awareness of PoS displays in students in years 7-11 in Nottinghamshire secondary schools [9 10]. Informed consent for school participation was obtained from head teachers, and opt-out consent for students by distributing forms to parents of all children in school years 7-11 (aged 11-16). All students whose parents and who themselves did not decline participation were invited to fill in a paper based questionnaire under teacher supervision. Of the 11 schools surveyed in 2011 eight agreed to participate in 2012, and seven of these (and one other school which did not participate in 2012) provided data in 2013. Ethics approval for the study was provided by the University of Nottingham School of Education Research Ethics Committee. Further details on data collection are available elsewhere [9 10].

Variables included

Our questionnaire collected information on demographic variables (age, sex, ethnicity); postcode, which was used to calculate Index for Multiple Deprivation (IMD) quintiles as a measure of socioeconomic status; rebelliousness, self-perceived academic performance, smoking among family members and friends, and whether smoking was allowed in the student's home. As in previous analyses of data from these surveys [9 10] our main exposure variables were frequency of visiting shops; frequency of noticing PoS displays in these shops; and the number of tobacco brands recognized. Questions about noticing PoS displays and visiting shops were asked separately for small shops and large shops and we looked at the changes in the proportion of children noticing PoS and visiting each type of shops between 2012 and 2013. However, to avoid categories with small numbers, when we investigated changes in susceptibility we combined responses on small and large shops into a single variable measuring maximum frequency of visiting either type of shop.

Frequency of visiting shops was coded as a binary variable with two categories: at least two or three times a week, and less than two or three times a week. Frequency of noticing also was coded into binary categories: sometime or less, and most or every time. Number of brands recognized was coded into three distinct categories: none, 1-5 brands, and more than 5 brands. We also combined related exposure variables into a single joint exposure; specifically the frequency of noticing PoS displays and the frequency of visiting shops; and frequency of noticing PoS displays and the number of brands recognized. Our main outcome variables were reported changes in susceptibility to smoking defined using previously validated questions by Pierce et al. [11 13], and change in smoking status from never- to ever-smoker. Further details on the variables included can be found in a paper reporting data from the 2011 and 2012 surveys [10].

Analysis

Exposure was defined in relation to 2012 questionnaire responses, and outcomes from change between 2012 and 2013. We linked data on individual student responses in 2012 and 2013 using the student's name, school and school year. We first investigated whether frequency of noticing PoS displays changed between 2012 and 2013, and whether these changes differed between small and large shops. We then investigated whether changes in susceptibility to smoking and smoking uptake between 2012 and 2013 were related to exposure to and awareness of tobacco PoS displays in 2012 after adjusting for potential confounders. We used four main outcome variables: 1) the proportion of children who were non-susceptible never smokers in 2012 and became susceptible in 2013; 2) the proportion of children who were non-susceptible never smokers in 2012 and became smokers in 2013; 3) the proportion of children who were susceptible never smokers in 2012 and became smokers in 2013; and 4) the proportion of children who were susceptible never smokers in 2012 and reverted to being non-susceptible never smokers in 2013. Students with missing values for outcome variables were excluded from the analysis; missing values for the exposure variables were included in the analysis as a separate category to maximise study power.

As in our previous analyses we used multinomial logistic regression to estimate relative risk ratios (RRRs) for change in susceptibility and smoking status in relation to frequency of visiting shops, frequency of noticing PoS displays, number of brands recognized and variables that combine these. To allow for multiple hypothesis testing we set our statistical significance threshold at a probability of 1%, and calculated 99% confidence intervals (CI). We used a cluster sandwich estimator to account for clustering within classes and schools. Data were analysed using Stata v.11 (Stata Corp. College Station, TX).

Results

From the seven schools participating in the surveys in both 2012 and 2013 we received 3,989 and 4,014 responses respectively, of which 3,216 children were in school years 8-11 in 2013 and hence eligible for data linkage with 2012 responses. Of these we successfully identified and linked responses for 1,918 children (59.6%). We then excluded 37 children who did not provide data on susceptibility to smoking in both years, and 35 with incompatible responses on susceptibility (18 children reported that they were ever smokers in 2012 but then non-susceptible never smokers in 2013, and 17 children reported that they were ever smokers in 2012 but susceptible never smokers in 2013). We also excluded two children who indicated that they were 10 years old in 2013. Thus, final analysis included responses from 1,844 children.

In 2012, 1,229 children (66.7%) were non-susceptible never smokers, 408 (22.1%) were susceptible never smokers and 207 (11.2%) were ever smokers. Of non-susceptible never smokers in 2012, 224 (18.2%) progressed to become susceptible in 2013, and 68 (5.5%) became smokers. Of the 408 susceptible never smokers in 2012, 107 children (26.2%) reverted to become non-susceptible, and 111 (27.2%) became smokers in 2013. The proportion of children in the cohort who had tried smoking increased from 11.2% in 2012 to 20.9% in 2013.

Table 1 displays summary data on a range of smoking and related variables from 2012 and 2013 and demonstrates little change in (for example) deprivation score, parental and sibling smoking, smoking in the family home, academic performance and rebelliousness; but identifies an increase in the number of friends who smoke, consistent with the overall increase in prevalence of ever-smoking within the cohort.

The proportion of children who reported noticing tobacco PoS displays most or every time they visited a supermarket fell from 57.9% in 2012 to 46.9% in 2013. There was also a small reduction in the proportion of children noticing PoS displays most or every time they visited a small shop, from 71.6% in 2012 to 68.0% in 2013 though the frequency of visiting shops remained stable (see Table 1).

Table 1: Summary of 2012 and 2013 data for the 1,844 participants with linked responses

Variable	2012 (number, %)	2013 (number, %)
Sex		
Boy	901 (48.9)	901 (48.9)
Girl	943 (51.1)	943 (48.9)
Age		
11	143 (7.8)	
12	411 (22.3)	110 (6.0)
13	658 (35.7)	374 (26.3)
14	502 (27.2)	630 (34.2)
15	125 (6.8)	585 (31.7)
16		141 (7.7)
Missing	5 (0.3)	4 (0.2)
Deprivation quintile		
1(least deprived)	455 (24.7)	456 (24.7)
2	183 (9.9)	178 (9.7)
3	291 (15.8)	298 (16.2)
4	277 (15.0)	287 (15.6)
5 (most deprived)	259 (14.1)	263 (14.3)
Missing	379 (20.6)	362 (19.6)
Parental smoking		
Neither parent smokes	1,258 (68.2)	1,299 (70.4)
One parent smokes	378 (20.5)	376 (20.4)
Both parents smoke	169 (9.2)	160 (8.7)
Missing	39 (2.1)	9 (0.5)
Sibling smoking		
None smokes	1,623 (88.0)	1,619 (87.8)
At least one smokes	182 (9.9)	216 (11.7)
Missing	39 (2.1)	9 (0.5)
Smoking in the main family home		
Not allowed	1,541 (83.6)	1,559 (84.5)
Allowed	260 (14.1)	270 (14.6)
Missing	42 (2.3)	15 (0.8)
Number of smoking friends		
None	710 (38.5)	560 (30.4)
One or two	270 (14.6)	304 (16.5)
Three or more	374 (20.3)	484 (26.3)
Not sure	454 (24.6)	475 (25.8)
Missing	36 (2.0)	21 (1.1)
Self-perceived academic performance		
Excellent or good	1,389 (75.3)	1,337 (72.5)
Average or below average	414 (22.5)	491 (26.6)
Missing	41 (2.2)	16 (0.9)
Rebelliousness		
Low	1,051 (57.0)	1,064 (57.7)
High	699 (37.9)	728 (39.5)
Missing	94 (5.1)	52 (2.8)
Susceptibility to smoking		
Non susceptible never smoker	1,229 (66.7)	1,044 (56.6)
Susceptible never smoker	408 (22.1)	414 (22.5)
Ever smoker	207 (11.2)	386 (20.9)
Notice cigarettes on displays in large shops		
Sometimes or less	703 (38.1)	911 (49.4)
Most times or every time	1,068 (57.9)	863 (46.8)
Missing	73 (4.0)	70 (3.8)
Notice cigarettes on displays in small shops		
Sometimes or less	410 (22.2)	510 (27.7)
Most times or every time	1,321 (71.6)	1254 (68.0)
Missing	113 (6.1)	80 (4.3)
Notice cigarettes on displays (small shops and large shops combined)		
Sometimes or less	350 (19.0)	471 (25.5)
Most times or every time	1,467 (79.6)	1,354 (73.4)
Missing	27 (1.5)	19 (1.0)
Frequency of visiting large shops		
Less than 2 or 3 times a week	1,112(60.3)	1,147 (62.2)
At least 2 or 3 times a week	714 (38.7)	685 (37.2)

Missing	18 (1.0)	12 (0.7)
Frequency of visiting small shops		
Less than 2 or 3 times a week	917 (49.7)	986 (53.47)
At least 2 or 3 times a week	908 (49.2)	846 (45.9)
Missing	19 (1.0)	12 (0.7)
Frequency of visiting shops (small shops and large shops combined)		
Less than 2 or 3 times a week	668 (36.2)	733 (39.8)
At least 2 or 3 times a week	1,166 (63.2)	1,107 (60.0)
Missing	10 (0.5)	4 (0.2)
Number of brands recognized		
None	468 (25.4)	434 (23.5)
1 to 5 brands	636 (34.5)	627 (34.0)
More than 5 brands	561 (30.4)	613 (33.2)
Missing	179 (9.7)	170 (9.2)

Changes in smoking susceptibility and status in relation to exposure variables at univariable level

Analysis at univariable level suggested that among those who were non-susceptible in 2012, the risk of becoming susceptible to smoking in 2013 was higher among older students, particularly those who were aged 14 in 2012 (Table 2). Although the associations were not statistically significant, the risk of becoming susceptible to smoking among students who were non-susceptible at baseline was also higher among those who had parents or friends who smoke, higher levels of rebelliousness, or recognised at least five tobacco brands in 2012. The risk of becoming a smoker among students who were non-susceptible at baseline was also higher in older age groups, among those with parents who smoke, with higher numbers of smoking friends, lower levels of self-perceived academic performance and higher levels of rebelliousness (Table 2). Among children who were susceptible to smoking at baseline the risk of becoming a smoker increased strongly with age, and was higher in those with siblings or friends who smoke, those with lower educational achievement, and higher level of rebelliousness (Table 2).

All of these status changes were also more likely in those who visited shops more frequently, or recognised more brands, but were unrelated to noticing PoS displays. These changes were all most marked in those in the highest categories of combined exposure variables, and significantly so for the highest frequency of noticing PoS displays and visiting shops (RRR 3.39; 99% CI 1.31-8.76, p=0.001).

Table 2: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Sex												
Boy	1.00			1.00			1.00			1.00		
Girl	1.13	0.62-2.05	0.608	0.87	0.40-1.89	0.639	0.91	0.57-1.46	0.616	0.63	0.35-1.16	0.052
Age												
11	1.00			1.00			1.00			1.00		
12	1.30	0.74-2.31	0.232	1.46	0.27-7.94	0.562	0.43	0.11-1.74	0.120	1.64	0.23-11.72	0.516
13	1.78	0.99-3.19	0.011	2.45	0.75-8.02	0.052	0.48	0.08-2.75	0.277	2.50	0.59-10.54	0.101
14	2.05	1.32-3.17	<0.001	3.90	1.35-11.28	0.001	0.35	0.07-1.66	0.082	2.13	0.36-12.60	0.274
15	1.60	0.52-4.93	0.279	4.81	0.49-47.52	0.077	0.60	0.05-6.72	0.586	7.50	1.28-43.94	0.003
Quintile of Index of Multiple Deprivation												
1 (least deprived)	1.00			1.00			1.00			1.00		
2	1.12	0.69-1.79	0.554	1.80	0.55-5.85	0.200	1.13	0.54-2.39	0.673	0.85	0.52-1.40	0.408
3	1.49	0.62-3.56	0.237	1.38	0.62-3.08	0.294	0.94	0.46-1.92	0.826	0.79	0.56-1.11	0.073
4	1.19	0.70-2.04	0.403	1.73	0.57-5.23	0.204	1.48	0.80-2.74	0.104	1.16	0.53-2.56	0.618
5(most deprived)	0.86	0.46-1.67	0.565	1.46	0.51-4.20	0.356	1.43	0.62-3.28	0.269	1.53	0.79-2.98	0.100
Parental smoking												
Neither parent smokes	1.00			1.00			1.00			1.00		
One parent smokes	1.53	1.09-2.15	0.001	1.81	0.74-4.41	0.087	0.88	0.50-1.54	0.554	0.64	0.19-2.22	0.356
Both parents smoke	1.18	0.50-2.75	0.622	1.82	1.05-3.16	0.005	0.56	0.35-0.91	0.002	0.95	0.35-2.60	0.897
Sibling smoking												
None smokes	1.00			1.00			1.00			1.00		
At least one smokes	1.13	0.49-2.59	0.711	2.08	0.72-6.03	0.077	0.80	0.36-1.78	0.467	2.62	0.83-8.26	0.031
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	1.82	0.98-3.41	0.013	2.52	0.94-6.71	0.015	0.75	0.19-2.88	0.579	1.17	0.66-2.07	0.480
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.63	1.19-2.21	<0.001	3.35	1.59-7.06	<0.001	0.76	0.27-2.14	0.499	1.89	0.72-4.95	0.090
Three or more	1.99	0.98-4.01	0.012	6.05	2.67-13.69	<0.001	0.66	0.22-1.99	0.334	2.28	0.97-5.39	0.013
Not sure	1.21	0.72-2.03	0.356	2.33	1.48-3.68	<0.001	0.71	0.33-1.54	0.259	1.91	0.85-4.31	0.041

Self-perceived academic performance												
Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	1.26	0.63-2.51	0.393	2.57	1.10-6.00	0.004	1.12	0.68-1.83	0.570	1.49	0.86-2.59	0.065
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.89	1.06-3.38	0.005	3.15	1.78-5.58	<0.001	0.99	0.58-1.67	0.944	1.72	1.17-2.53	<0.001
Noticing point of sale displays												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.12	0.50-2.52	0.708	1.08	0.34-3.45	0.860	0.68	0.34-1.35	0.144	0.24	0.82-6.09	0.038
Frequency of visiting shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.42	0.89-2.26	0.054	2.10	1.22-3.61	<0.001	0.77	0.31-1.93	0.469	1.82	0.93-3.56	0.021
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.21	0.85-1.72	0.160	1.28	0.67-2.45	0.320	0.50	0.28-0.89	0.002	1.48	0.80-2.72	0.100
More than 5	2.01	1.15-3.52	0.001	2.31	0.86-6.19	0.029	0.52	0.34-0.79	<0.001	1.77	0.86-3.63	0.041
Combined frequency of visiting and noticing displays												
Visit <2/3 times per week/Notice sometimes or less	1.00			1.00			1.00			1.00		
Visit <2/3 times per week/Notice most or every time	1.52	0.68-3.43	0.182	0.86	0.23-3.26	0.776	0.63	0.34-1.18	0.560	2.04	0.59-7.05	0.138
Visit >2/3 times per week/Notice sometimes or less	2.33	0.74-7.27	0.056	1.88	0.54-6.52	0.190	0.69	0.10-5.03	0.633	1.67	0.46-6.06	0.308
Visit >2/3 times per week/Notice most or every time	1.88	0.73-4.87	0.087	1.87	0.58-6.02	0.169	0.54	0.15-1.91	0.208	3.39	1.31-8.76	0.001
Combined frequency of noticing displays and brand recognition												
Notice sometimes or less/0 brands	1.00			1.00			1.00			1.00		
Notice sometimes or less /1-5 brands	2.11	1.25-3.58	<0.001	0.93	0.26-3.29	0.876	0.53	0.20-1.38	0.086	1.13	0.06-21.43	0.918
Notice sometimes or less /6+ brands	1.49	0.33-6.67	0.495	$2.72e^{-06}$	$5.07e^{-06}$	<0.001	0.18	0.02-1.40	0.031	1.80	0.10-32.57	0.601
Notice most or every time/0 brands	1.13	0.36-3.56	0.783	0.54	0.13-2.22	0.265	0.85	0.49-1.48	0.455	2.13	0.14-32.90	0.476
Notice most or every time /1-5 brands	1.20	0.47-3.07	0.612	0.94	0.36-2.45	0.858	0.40	0.17-0.96	0.007	2.79	0.18-43.18	0.336
Notice most or every time /6+ brands	2.19	0.97-4.93	0.013	1.77	0.42-7.69	0.306	0.47	0.20-1.08	0.020	3.12	0.29-33.29	0.217

*Could not estimate due to small numbers

Changes in smoking susceptibility and status in relation to exposure variables at multivariable level

In a multivariable analysis after adjusting for major confounders (age, sex, parental smoking, friend smoking, perceived academic performance and rebelliousness) there was an indication that among non-susceptible never smokers at baseline there was an increased risk of becoming susceptible or becoming a smoker among those who were more frequent visitors to shops, recognised more tobacco brands, and were in the highest levels of the combined exposure variables, but none of these associations was statistically significant at the 1% level (Table 3). Among susceptible never smokers at baseline, the risk of becoming an ever smoker was higher among students who noticed PoS displays more often, visited shops more often, recognized a higher number of brands, and had higher levels of exposure measured by combined variable including frequency of noticing PoS displays and visiting shops. However none of these associations was statistically significant (Table 3).

Table 3: Adjusted relative risk ratios for changes in susceptibility and smoking status in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised

	Among non-susceptible never-smokers at baseline (n=1229)						Among susceptible never-smokers at baseline (n=408)					
	RRR of becoming susceptible[a]			RRR of becoming an ever smoker[a]			RRR of becoming non-susceptible[b]			RRR of becoming an ever smoker[b]		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.06	0.65-1.73	0.740	0.96	0.42-2.22	0.908	0.68	0.30-1.57	0.236	1.98	0.65-6.02	0.115
Frequency of visiting shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.35	0.90-2.04	0.057	1.84	0.87-3.92	0.037	0.71	0.37-1.37	0.181	1.73	0.84-3.58	0.052
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.11	0.67-1.84	0.608	1.02	0.41-2.52	0.952	0.48	0.20-1.15	0.031	1.34	0.47-3.84	0.479
More than 5	1.61	0.92-2.80	0.028	1.33	0.52-3.43	0.435	0.51	0.21-1.22	0.046	1.68	0.59-4.80	0.200
Combined frequency of visiting and noticing displays												
Visit <2/3 times per week/Notice sometimes or less	1.00			1.00			1.00			1.00		
Visit <2/3 times per week/Notice most or every time	1.50	0.69-3.26	0.174	0.82	0.21-3.19	0.712	0.62	0.19-2.07	0.310	1.77	0.29-10.78	0.416
Visit >2/3 times per week/Notice sometimes or less	2.33	0.96-5.71	0.014	1.71	0.38-7.63	0.353	0.61	0.13-2.85	0.412	1.28	0.14-11.54	0.774
Visit >2/3 times per week/Notice most or every time	1.75	0.84-3.66	0.050	1.52	0.46-5.07	0.370	0.51	0.17-1.57	0.122	2.85	0.51-15.91	0.117
Combined frequency of noticing displays and brand recognition												
Notice sometimes or less/0 brands	1.00			1.00			1.00			1.00		
Notice sometimes or less /1-5 brands	2.08	0.78-5.52	0.053	0.92	0.15-5.64	0.909	0.37	0.06-2.20	0.152	0.77	0.05-11.14	0.800
Notice sometimes or less /6+ brands	1.10	0.18-6.77	0.896	-*	-*	-*	0.14	0.01-3.10	0.100	1.29	0.06-26.71	0.828
Notice most or every time/0 brands	1.13	0.52-2.48	0.685	0.56	0.14-2.17	0.269	0.66	0.15-3.00	0.479	1.65	0.16-16.54	0.576
Notice most or every time /1-5 brands	1.10	0.54-2.27	0.728	0.76	0.25-2.32	0.531	0.33	0.08-1.30	0.038	2.12	0.26-17.55	0.359
Notice most or every time /6+ brands	1.76	0.84-3.70	0.048	1.08	0.35-3.32	0.859	0.39	0.10-1.49	0.070	2.48	0.30-20.34	0.266

[a] Adjusted for age, sex, parental smoking, friend smoking, self-perceived academic performance and rebelliousness; [b] Adjusted for age, sex and parental smoking

*Could not estimate due to small numbers

Discussion

To our knowledge this is the first individually linked cohort study to explore changes in susceptibility and smoking in relation to the removal of tobacco PoS displays from supermarkets and other large retailers in the UK. Our findings demonstrate that whilst students with high levels of exposure to PoS displays were on average more likely to progress to susceptibility or to uptake of smoking, the effects of PoS exposure, or indeed of tobacco brand recognition, on these transitions were not independently statistically significant.

Our study findings are limited by low power arising from the relatively small number of participants for whom linked data could be identified, and the small number of individuals making the progression to susceptibility or smoking uptake. In this third wave of our cohort study, low participation by schools meant that we were able to link data from only seven out of the initial 11 schools, and linkage proved impossible for many participants as a result of missing or incomplete identity information. Another important limitation is that we were asking children about their exposure to and awareness of PoS displays separately for corner shops/newsagents and off-licences and for supermarkets, but cannot be sure that respondents were able to differentiate these two types of shops. For example, Tesco is typically known as supermarket in the UK but also has local stores which were sufficiently small to be excluded from the 2012 point of sale prohibition.

We measured changes in susceptibility and smoking status one year after the large retailer PoS display ban was implemented in England, and it is possible that a longer period may have had more substantial effects on children's smoking. Although our findings relate to children's smoking, they are consistent with data from Ireland, where there was no immediate decrease in general smoking prevalence after implementation of a PoS ban [14]. However, the ban in Ireland led to a reduction in perceived smoking prevalence among young people, and adults suggested that removal of PoS displays made quitting easier [14].

Cross-sectional and linked data from earlier waves of this cohort study clearly indicated that exposure to and awareness of tobacco PoS displays was associated with increased risk of becoming susceptible to smoking and also becoming a smoker [9 10]. Previous studies elsewhere have also consistently suggest that being exposed to tobacco PoS promotion leads to increased likelihood of becoming susceptible to smoking, experimenting with smoking or becoming regular or occasional smoker [15]. Although this tobacco policy is primarily aimed at reducing smoking uptake among children, it appears to have an effect on adult smoking by reducing the number of impulse purchases in jurisdictions where PoS bans are implemented [16]. Evaluation of the Irish tobacco PoS display ban suggested that removal of PoS displays had a potential to de-normalize smoking and young people felt that it could make it easier for them to abstain from smoking uptake [14]. Similarly, in Norway a PoS display ban implemented in 2010 was perceived as a barrier limiting access to tobacco products affecting brand attachment and therefore leading to de-normalization of smoking [17].

Evidence from previous research suggest that 2012 partial ban had no immediate effect on smoking prevalence and cigarette consumption among adults, though a steeper reduction was observed over three years post ban [18]. Our findings indicate however that whilst prohibition of PoS tobacco displays in large shops in England reduced the proportion of young people reporting exposure to the displays, the removal did not result in a significant reduction in smoking behaviour among young people. Further work is required to determine whether removal of PoS displays in smaller shops, which tend to be the greater source of exposure of young people and which were afforded an exclusion from the English PoS prohibition until April 2015 has yielded a greater effect.

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Contributorship statement

IB was involved in designing the study, collected and analysed the data and drafted the manuscript.

AM contributed substantially to the design of the work and revised and approved the manuscript.

JB contributed substantially to designing the study, was involved in analysis of the data, contributed to drafting the manuscript and approved the manuscript

Competing interests

None

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Data sharing statement

Data available as part of this project will be managed (by UK Centre for Tobacco and Alcohol Studies and shared according to the UKCTAS data management guidelines (available from: http://www.ukctas.ac.uk/ukctas/documents/datamanagement-guidelines.pdf).

Anonymized data used for this study will be available from the main author on request. No additional unpublished data are available.

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Investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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Investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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Abstract

Objective: A prospective evaluation of the effect of 2012 point-of-sale (PoS) display ban in supermarkets in England on perceived exposure to PoS displays, and on changes in susceptibility and smoking uptake among young people.

Design: Cohort study

Settings: Seven schools in Nottinghamshire, England

Participants: 1,035 11-16 year-old schoolchildren

Primary and secondary outcome measures: Changes in reported exposure to PoS displays before and after prohibition, and the association between exposure to and awareness of PoS displays and change in susceptibility to smoking and smoking status between 2011 and 2012 (before the ban) and 2012 and 2013 (after the ban).

Results: The proportion of children noticing tobacco PoS displays in supermarkets most or every time they visited a shop changed little between 2011 and 2012 (59.6% and 58.8% respectively); but decreased by about 13 percentage points to 45.7% in 2013, after the ban. However, after adjusting for confounders, implementation of the first stage of the PoS ban in 2012 did not result in significant changes in the relation between susceptibility to smoking and smoking status and exposure to and awareness of PoS displays.

Conclusions: Prohibition of PoS in large supermarkets resulted in a decline in the proportion of young people noticing PoS displays in large shops, but little or no change in smoking uptake or susceptibility. It remains to be seen whether extension of the PoS ban to all shops in 2015 has a more marked effect.

Strengths and limitations of this study:

- This is the first individually linked cohort study to investigate changes in exposure to and awareness of tobacco point-of-sale (PoS) displays, and changes in susceptibility to smoking and smoking uptake in relation to first stage of tobacco point-of-sale display ban in England.
- Data were collected using self-administered questionnaires including a wide range of variables: socio-demographic factors, smoking among peers and family, self-perceived academic performance and rebelliousness, smoking status and susceptibility to smoking, exposure to and awareness of tobacco PoS displays, and number of tobacco brands recognised.
- Our findings are limited by low power arising from the relatively small number of participants for whom linked data could be identified.
- Changes in susceptibility to smoking and smoking uptake were investigated one year after the implementation of the ban though longer follow-up time might be required to observe considerable changes in susceptibility as a result of reduced exposure and awareness.

Introduction

Smoking is the largest avoidable cause of death in the UK [1]. Although the prevalence of smoking among adults in Great Britain has declined substantially over recent decades [2] there are still about 9 million smokers in the UK [3], most of whom became smokers before the age of 18 [4]. Although smoking prevalence among young people in Britain has also declined, reaching 8% among 15 year olds in England in 2014, around 207,000 children start smoking every year in the UK [4]. Therefore policies to prevent smoking uptake among young people are of crucial public health importance.

Smoking prevalence has declined in the UK as a result of comprehensive tobacco control policies including legislation prohibiting most forms of tobacco advertising [5]. However until recently in the UK, this legislation provided an exemption for tobacco product displays at the point of sale (PoS). Previous studies have suggested that being exposed to tobacco PoS displays causes adults who intend to quit to make unplanned tobacco purchases [6], and that removal of PoS displays reduces these impulse purchases [7]. Findings from the International Tobacco Control Four Country Survey support these findings, suggesting that PoS display bans reduce exposure to tobacco marketing and the frequency of unplanned purchases of tobacco products [8]. Although there is less evidence on the effect of PoS displays on youth smoking behaviour, we have recently reported data from England suggesting that children with higher levels of exposure to tobacco PoS displays are more likely to be susceptible to smoking [9], and that noticing PoS displays more often was a prospective determinant of the onset of susceptibility [10]. Being susceptible to smoking is associated with an increased risk of experimentation with smoking, and smoking uptake, among adolescents [11].

In England in April 2012 tobacco PoS displays were banned in all large shops, defined as those with a floor area over 280 square meters [12]. In England, almost all shops of this size are supermarkets, although it should be noted that some supermarket chains also have 'express' outlets which are smaller and hence were not covered by this law. We now report an extension to our earlier work [9, 10] investigating whether this policy has reduced exposure to and awareness of tobacco at PoS

among young people, or altered the previously observed relation between exposure to PoS displays and becoming susceptible to smoking or smoking uptake.

Methods

Data collection

Between March and May 2013 we carried out the third in a series of cross-sectional surveys (previously carried out in March-May 2011 and March 2012) of smoking behaviour, exposure to and awareness of PoS displays in students in years 7-11 in Nottinghamshire secondary schools [9, 10]. Informed consent for school participation was obtained from head teachers, and opt-out consent for students by distributing forms to parents of all children in school years 7-11 (aged 11-16). All students whose parents and who themselves did not decline participation were invited to fill in a paper based questionnaire under teacher supervision. Of the 11 schools surveyed in 2011 eight agreed to participate in 2012, and seven of these (and one other school which did not participate in 2012) provided data in 2013. As for this study, we linked data for students in 2011, 2012 and 2013, we were able to link data for all years for these seven schools. Ethics approval for the study was provided by the University of Nottingham School of Education Research Ethics Committee. Further details on data collection are available elsewhere [9, 10].

Variables included

Our questionnaire collected information on demographic variables (age, sex, ethnicity); postcode, which was used to calculate Index for Multiple Deprivation (IMD) quintiles as a measure of socioeconomic status; rebelliousness, self-perceived academic performance, smoking among family members and friends, and whether smoking was allowed in the student's home. As in previous analyses of data from these surveys [9, 10] our main exposure variables were frequency of visiting shops; frequency of noticing PoS displays in these shops; and the number of tobacco brands recognized. Questions about noticing PoS displays and visiting shops were asked separately for small shops and large shops and we looked at the changes in the proportion of children noticing PoS and visiting each type of shops between 2011 and 2012, and 2012 and 2013. Frequency of visiting shops

was coded as a binary variable with two categories: at least two or three times a week, and less than two or three times a week. Frequency of noticing also was coded into binary categories: sometime or less, and most or every time. Number of brands recognized was coded into three distinct categories: none, 1-5 brands, and more than 5 brands. Our main outcome variables were reported changes in susceptibility to smoking defined using previously validated questions by Pierce et al. [11, 13], and change in smoking status from never- to ever-smoker. Further details on the variables included are available in the paper reporting data from the 2011 and 2012 surveys [10]. In this study we investigated changes in children who provided data in all three surveys, and compared changes observed between 2011 and 2012, and between 2012 and 2013, to explore the effects of implementation of the PoS display ban in large shops.

Analysis

We linked data on individual student responses in 2011, 2012 and 2013 using the student's name, school and school year. We explored changes in outcomes between 2011 and 2012 in relation to exposure variables and confounders in 2011 which captures pre-ban data, and then repeated the analysis looking at the changes in susceptibility and smoking status between 2012 and 2013 in relation to exposures in 2012 capturing changes following PoS display ban in large shops. We investigated these changes for small shops and large shops separately. We first investigated whether frequency of noticing PoS displays changed between three study years, and whether these changes differed between small and large shops. We then investigated whether changes in susceptibility to smoking and smoking uptake between 2011 and 2012 were related to exposure to and awareness of tobacco PoS displays in 2011, and whether changes between 2012 and 2013 were related to exposure to and awareness of tobacco PoS displays in 2012 after adjusting for potential confounders. We then compared these results to investigate whether association before and after implementation of PoS display ban in large shops and small shops differed. We used four main outcome variables: 1) the proportion of children who were non-susceptible never smokers in 2011

and 2012 and became susceptible in the following year; 2) the proportion of children who were non-susceptible never smokers in 2011 and 2012 and became smokers in the following year; 3) the proportion of children who were susceptible never smokers and became smokers in subsequent year; and 4) the proportion of children who were susceptible never smokers and reverted to being non-susceptible never smokers between 2011 and 2012, and 2012 and 2013. Students with missing values for outcome variables were excluded from the analysis; missing values for the exposure variables were included in the analysis as a separate category to maximise study power.

As in our previous analyses we used multinomial logistic regression to estimate relative risk ratios (RRRs) for change in susceptibility and smoking status in relation to frequency of visiting shops, frequency of noticing PoS displays, number of brands recognized and variables that combine these. To allow for multiple hypothesis testing we set our statistical significance threshold at a probability of 1%, and calculated 99% confidence intervals (CI). We used a cluster sandwich estimator to account for clustering within classes and schools. Data were analysed using Stata v.11 (Stata Corp. College Station, TX).

Results

From the seven schools participating in the 2011, 2012 and 2013 surveys we received completed questionnaires from 4019, 3989 and 4014 participants, respectively. After excluding children who did not participate in all three years, and those with missing information on outcome variables, a cohort of 1035 children remained for analysis.

Overall, the proportion of children who were non-susceptible never smokers decreased from year to year, from 77.5% in 2011, to 62.8% in 2012 and 55.3% in 2013. On the other hand, the proportion of children who were ever smokers increased considerably from 4.5% in 2011 to 20.7% in 2013. 19.8% of children who were non-susceptible to smoking in 2011 became susceptible in 2012, and 6.0% became ever smokers. Similar transitions were observed between 2012 and 2013 when 18.0% of those non-susceptible to smoking in 2012 became susceptible to smoking in 2013 and 5.2% became ever smokers.

Table 1 displays summary data on a range of smoking and related variables from all three years and demonstrates little change in (for example) deprivation score, parental and sibling smoking, smoking in the family home, academic performance and rebelliousness; but identifies an increase in the number of friends who smoke, consistent with the overall increase in prevalence of ever-smoking within the cohort.

The proportion of children who reported noticing tobacco PoS displays most or every time they visited a supermarket remained stable in 2011 and 2012 (59.6% and 58.8%, respectively) but fell slightly to 45.7% in 2013 after implementation of the PoS ban in large shops. There was also a small reduction in the proportion of children noticing PoS displays most or every time they visited a small shop, from 74.8% in 2012 to 67.3%% in 2013 though the frequency of visiting shops remained stable (see Table 1).

Table 1: Summary of 2011, 2012 and 2013 data for the 1,035 participants with linked responses

Variable	2011 (number, %)	2012 (number, %)	2013 (number, %)
Sex			
Boy	503 (48.6)	503 (48.6)	503 (48.6)
Girl	532 (51.4)	532 (51.4)	532 (51.4)
Age			
11	147 (14.2)		
12	416 (40.2)	147 (14.2)	
13	379 (36.6)	434 (41.9)	105 (10.1)
14	90 (8.7)	365 (35.3)	406 (39.2)
15		88 (8.5)	420 (40.6)
16			101 (9.8)
Missing	3 (0.3)	1 (0.1)	3 (0.3)
Deprivation quintile			
1(least deprived)	314 (30.3)	338 (32.7)	287 (27.6)
2	107 (10.3)	115 (11.1)	101 (9.7)
3	180 (17.4)	201 (19.4)	165 (15.9)
4	157 (15.2)	181 (17.5)	160 (15.4)
5 (most deprived)	132 (12.8)	151 (14.6)	130 (12.5)
Missing	145 (14.0)	49 (4.7)	197 (18.9)
Parental smoking			
Neither parent smokes	743 (71.8)	749 (72.4)	758 (73.2)
One parent smokes	192 (18.6)	188 (18.2)	202 (19.5)
Both parents smoke	90 (8.7)	76 (7.3)	71 (6.9)
Missing	10 (1.0)	22 (2.1)	4 (0.4)
Sibling smoking			
None smokes	963 (92.6)	928 (89.2)	934 (89.8)
At least one smokes	67 (6.4)	90 (8.7)	101 (9.7)
Missing	10 (1.0)	22 (2.1)	5 (0.5)
Smoking in the main family home			
Not allowed	870 (84.1)	893 (86.3)	896 (86.6)
Allowed	155 (15.0)	121 (11.7)	134 (13.0)
Missing	10 (1.0)	21 (2.0)	5 (0.5)
Number of smoking friends			
None	618 (59.7)	368 (35.6)	306 (29.6)
One or two	115 (11.1)	153 (14.8)	181 (17.5)
Three or more	94 (9.1)	233 (22.5)	290 (28.2)
Not sure	196 (19.0)	258 (24.9)	250 (24.2)
Missing	12 (1.2)	23 (2.2)	8 (0.8)
Self-perceived academic performance			
Excellent or good	830 (80.2)	794 (76.7)	781 (75.5)
Average or below average	185 (17.9)	220 (21.3)	249 (24.1)
Missing	20 (1.9)	21 (2.0)	5 (0.5)
Rebelliousness			
Low	592 (57.2)	593 (57.3)	619 (59.8)
High	420 (40.6)	395 (38.2)	390 (37.7)
Missing	23 (2.2)	47 (4.5)	26 (2.5)
Susceptibility to smoking			
Non susceptible never smoker	802 (77.5)	650 (62.8)	572 (55.3)
Susceptible never smoker	186 (18.0)	250 (24.2)	249 (24.1)
Ever smoker	47 (4.5)	135 (13.0)	214 (20.7)
Notice cigarettes on displays in large shops			
Sometimes or less	401 (38.7)	388 (37.5)	524 (50.6)
Most times or every time	617 (59.6)	609 (58.8)	473 (45.7)
Missing	17 (1.6)	38 (3.7)	38 (3.7)
Notice cigarettes on displays in small shops			
Sometimes or less	259 (25.0)	210 (20.3)	290 (28.0)
Most times or every time	745 (72.0)	774 (74.8)	697 (67.3)
Missing	31 (3.0)	51 (4.9)	48 (4.6)
Frequency of visiting large shops			
Less than 2 or 3 times a week	360 (34.8)	356 (34.4)	344 (33.2)
At least 2 or 3 times a week	667 (64.4)	669 (64.6)	689 (66.6)
Missing	8 (0.8)	10 (1.0)	2 (0.2)
Frequency of visiting small shops			
Less than 2 or 3 times a week	485 (46.9)	493 (47.6)	435 (42.0)

At least 2 or 3 times a week	540 (52.2)	535 (51.7)	598 (57.8)
Missing	10 (1.0)	7 (0.7)	2 (0.2)
Number of brands recognized			
None	282 (27.3)	232 (22.4)	227 (21.9)
1 to 5 brands	381 (36.8)	362 (35.0)	365 (35.3)
More than 5 brands	239 (23.1)	346 (33.4)	356 (34.4)
Missing	133 (12.9)	95 (9.2)	87 (8.4)

Changes in smoking susceptibility and status in relation to exposure variables at univariable level

Analysis at univariable level suggested that among those who were non-susceptible to smoking in 2011 the risk of becoming susceptible to smoking in 2012 was higher among older students with lower levels of self-perceived academic performance, higher levels of rebelliousness, visited large shops less frequently, but recognized a higher number of brands (Table 2). The risk of becoming susceptible to smoking in 2013 among non-susceptible never smokers in 2012 was higher among students who visited large shops less frequently, among those living in homes where smoking was allowed , and those who recognized a higher number of tobacco brands (Table 3).

An increased risk of becoming an ever smoker in 2012 among those who were non-susceptible never smokers in 2011 was associated with age, both parents being smokers, greater number of smoking friends, noticing PoS displays in small shops more often, recognizing greater number of tobacco brands and lower frequency of visiting small shops. Among those who were non-susceptible to smoking in 2012, the risk of becoming an ever smoker in 2013 was higher among children with a greater number of smoking friends, for whom smoking was allowed in their main home, those with lower levels of self-perceived academic performance and those who visited large shops less frequently.

Among children who were susceptible to smoking in 2011, the risk of becoming an ever smoker was higher among children with smoking parents and siblings and greater number of smoking friends, though among those who were susceptible to smoking in 2012 the risk of becoming an ever smoker in 2013 was associated with having smoking siblings and visiting both large and small shops less frequently (Table 3).

Table 2: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables 2011-2012

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Sex												
Boy	1.00			1.00			1.00			1.00		
Girl	1.03	0.62-1.72	0.883	1.28	0.55-2.98	0.446	0.68	0.15-3.08	0.513	1.25	0.69-2.26	0.332
Age												
11	1.00			1.00			1.00			1.00		
12	0.90	0.40-2.03	0.746	2.62	0.55-12.51	0.114	0.87	0.17-4.53	0.829	0.46	0.14-1.57	0.105
13	0.97	0.49-1.91	0.894	5.94	1.33-26.49	0.002	0.31	0.07-1.36	0.041	0.74	0.36-1.50	0.271
14	1.03	0.51-2.10	0.908	9.29	1.49-57.78	0.002	0.62	0.27-1.43	0.137	0.98	0.37-2.62	0.968
15												
Quintile of Index of Multiple Deprivation												
1 (least deprived)	1.00			1.00			1.00			1.00		
2	1.78	1.33-2.39	<0.001	1.63	0.72-37.33	0.686	0.53	0.37-0.77	<0.001	1.47	0.32-6.89	0.517
3	1.32	0.85-2.07	0.106	1.91	0.37-9.90	0.312	0.42	0.16-1.09	0.020	1.41	0.28-7.13	0.583
4	1.01	0.50-2.03	0.977	0.92	0.14-6.26	0.915	1.28	0.39-4.15	0.722	4.26	0.90-20.24	0.017
5(most deprived)	1.61	0.51-5.08	0.284	1.97	0.18-21.26	0.462	0.27	0.05-1.49	0.048	1.77	0.58-5.39	0.187
Parental smoking												
Neither parent smokes	1.00			1.00			1.00			1.00		
One parent smokes	1.73	0.99-3.04	0.011	2.94	0.83-10.43	0.028	1.84	0.61-5.59	0.158	2.68	1.27-5.64	0.001
Both parents smoke	1.37	0.48-3.96	0.441	3.29	1.06-10.24	0.007	1.17	0.22-6.27	0.814	2.61	1.78-5.77	0.002
Sibling smoking												
None smokes	1.00			1.00			1.00			1.00		
At least one smokes	1.57	0.51-4.86	0.303	2.42	0.62-9.53	0.096	1.38	0.33-5.80	0.568	3.77	1.10-12.84	0.005
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	1.63	0.81-3.27	0.073	4.51	2.69-7.56	<0.001	1.23	0.33-4.56	0.683	1.20	0.31-4.72	0.727
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.97	0.80-4.87	0.055	2.85	0.58-14.07	0.090	0.58	0.10-3.44	0.415	1.03	0.24-4.39	0.961
Three or more	2.32	0.70-7.68	0.069	8.23	4.32-15.65	<0.001	0.41	0.05-3.36	0.276	2.67	1.06-6.73	0.006
Not sure	1.66	1.07-2.60	0.003	3.12	0.94-10.32	0.014	0.62	0.24-1.61	0.129	1.16	0.52-2.58	0.641

Self-perceived academic performance												
Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	2.03	1.04-3.94	0.006	1.90	0.92-3.92	0.023	0.53	0.21-1.31	0.070	0.81	0.42-1.56	0.413
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.73	1.27-2.35	<0.001	3.78	2.78-5.14	<0.001	0.87	0.55-1.39	0.452	2.17	0.63-7.51	0.107
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.37	0.95-1.96	0.027	3.17	0.92-10.93	0.017	0.97	0.50-1.90	0.911	0.95	0.49-1.85	0.850
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.58	0.43-0.78	<0.001	0.63	0.31-1.25	0.080	1.03	0.57-1.86	0.906	0.73	0.40-1.35	0.193
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.23	0.93-1.63	0.062	2.42	1.17-5.00	0.002	0.66	0.20-2.22	0.377	1.39	0.63-3.08	0.279
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.93	0.73-1.18	0.433	0.36	0.29-0.46	<0.001	1.01	0.56-1.84	0.950	0.37	0.12-1.11	0.020
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.64	0.87-3.08	0.044	2.24	0.91-5.53	0.021	0.98	0.25-3.82	0.976	2.05	0.71-5.94	0.081
More than 5	2.67	1.65-4.33	<0.001	6.07	2.38-15.46	<0.001	0.60	0.20-1.78	0.227	2.78	0.75-10.32	0.044

Table 3: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables 2012- 2013

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Sex												
Boy	1.00			1.00			1.00			1.00		
Girl	1.29	0.50-3.31	0.489	0.89	0.57-1.38	0.483	0.59	0.24-1.45	0.130	0.57	0.26-1.24	0.061
Age												
12	1.00			1.00			1.00			1.00		
13	1.24	0.46-3.37	0.575	1.49	0.47-4.72	0.372	0.89	0.42-1.87	0.689	2.57	0.63-10.53	0.084
14	1.65	0.72-3.77	0.122	1.65	0.53-5.08	0.255	0.61	0.23-1.67	0.210	2.33	0.43-12.44	0.195
15	1.32	0.60-2.89	0.358	1.42	0.59-3.42	0.309	1.36	0.33-5.55	0.577	6.11	0.58-64.41	0.048
Quintile of Index of Multiple Deprivation												
1 (least deprived)	1.00			1.00			1.00			1.00		
2	0.81	0.49-1.33	0.277	1.78	0.27-11.60	0.426	0.81	0.49-1.33	0.277	1.78	0.27-11.60	0.426
3	0.60	0.25-1.42	0.124	0.81	0.21-3.14	0.687	0.60	0.25-1.42	0.124	0.81	0.21-3.14	0.687
4	1.36	0.63-2.93	0.298	1.71	0.47-6.26	0.285	1.36	0.63-2.93	0.298	1.71	0.47-6.26	0.285
5(most deprived)	0.98	0.44-2.21	0.961	1.73	0.51-5.84	0.243	0.98	0.44-2.21	0.961	1.73	0.51-5.84	0.243
Parental smoking												
Neither parent smokes	1.00			1.00			1.00			1.00		
One parent smokes	1.36	0.90-2.06	0.057	2.34	0.88-6.21	0.025	1.00	0.49-2.03	0.994	1.02	0.23-4.58	0.968
Both parents smoke	1.30	0.66-2.58	0.321	1.66	0.22-12.29	0.514	0.61	0.12-3.22	0.444	1.37	0.26-7.22	0.630
Sibling smoking												
None smokes	1.00			1.00			1.00			1.00		
At least one smokes	0.60	0.13-2.76	0.383	0.81	0.20-3.34	0.703	0.70	0.21-2.32	0.443	2.75	1.11-6.77	0.004
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	2.00	1.11-3.60	0.002	4.11	1.05-16.14	0.008	1.18	0.20-6.84	0.813	1.85	0.68-4.99	0.111
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.51	0.73-3.11	0.144	1.94	0.89-4.26	0.029	0.75	0.17-3.30	0.623	2.48	0.36-17.08	0.225
Three or more	1.67	0.65-4.26	0.161	6.38	1.63-25.04	<0.001	0.57	0.15-2.15	0.278	3.09	0.43-22.11	0.140
Not sure	1.14	0.60-2.14	0.604	2.55	1.05-6.21	0.007	0.57	0.24-1.35	0.090	2.43	0.37-16.01	0.226
Self-perceived academic performance												

Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	1.03	0.48-2.22	0.923	2.11	1.03-4.33	0.007	1.40	0.87-2.27	0.070	1.40	0.68-2.89	0.230
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.89	0.77-4.65	0.068	2.82	0.99-7.99	0.011	1.09	0.59-2.04	0.710	1.48	0.64-3.47	0.230
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.79	0.52-1.18	0.128	1.01	0.43-2.38	0.966	0.52	0.33-0.81	<0.001	1.85	0.72-4.72	0.093
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.56	0.33-0.96	0.005	0.41	0.17-0.97	0.008	0.74	0.39-1.40	0.226	0.54	0.32-0.93	0.003
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.80	0.42-1.54	0.383	0.89	0.36-2.20	0.736	0.79	0.25-2.52	0.603	1.38	0.37-5.12	0.532
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.01	0.61-1.68	0.952	0.36	0.11-1.17	0.025	0.90	0.27-3.03	0.829	0.23	0.09-0.55	<0.001
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.20	0.69-2.09	0.406	1.14	0.34-3.79	0.781	0.40	0.15-1.07	0.016	1.07	0.38-3.04	0.859
More than 5	1.81	1.29-2.54	<0.001	2.02	0.50-8.14	0.195	0.53	0.12-2.25	0.256	1.83	0.59-5.69	0.170

Changes in smoking susceptibility and status in relation to exposure variables at multivariable level

In a multivariable analysis with adjustment for confounding by age, sex, deprivation, parental smoking, sibling smoking, smoking in the main family home, number of smoking friends, self-perceived academic performance and rebelliousness, the risk of becoming susceptible to smoking in 2012 among those who were non-susceptible never smokers in 2011 was unrelated to main exposure variables (frequency of visiting small and large shops and frequency of noticing PoS displays in large and small shops) though recognizing five or more tobacco brands was associated with a two-fold risk of becoming susceptible in 2012 (Table 4). However, none of the exposure variables were related to becoming susceptible in 2013 among children who were non-susceptible to smoking in 2012 Similarly, exposure variables other than recognizing more than five tobacco brands in 2011 were unrelated to becoming a smoker among children who were non-susceptible never smokers in 2011 and 2012. Also, none of the main exposure variables were related to becoming a smoker either in 2012 or 2013 among children who were susceptible to smoking in 2011 and 2012 (Table 5).

Table 4: Adjusted relative risk ratios for changes in susceptibility in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised between 2011-2012 and 2012-2013

	Among non-susceptible never-smokers at baseline 2011-2012						Among non-susceptible never-smokers at baseline 2012-2013					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.31	0.81-2.12	0.153	2.72	1.00-7.40	0.010	0.79	0.45-1.36	0.254	0.98	0.38-2.50	0.954
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.62	0.38-1.01	0.011	0.76	0.33-1.75	0.394	0.61	0.34-1.07	0.023	0.48	0.18-1.22	0.043
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.19	0.70-2.03	0.391	2.27	0.76-6.85	0.055	0.76	0.40-1.44	0.269	0.81	0.27-2.43	0.618
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.00	0.62-1.61	0.994	0.44	0.19-1.02	0.012	1.12	0.64-1.95	0.601	0.42	0.16-1.12	0.023
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.61	0.85-3.02	0.054	2.11	0.64-6.96	0.106	1.18	0.58-2.40	0.555	1.06	0.31-3.60	0.908
More than 5	2.49	1.23-5.02	0.001	4.96	1.51-16.34	0.001	1.60	0.75-3.44	0.110	1.47	0.41-5.29	0.437

Table 5: Adjusted relative risk ratios for changes in susceptibility in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised between 2011-2012 and 2012-2013

	Among susceptible never-smokers at baseline 2011-2012						Among susceptible never-smokers at baseline 2012-2013					
	RRR of becoming non-susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.84	0.32-2.18	0.635	0.97	0.34-2.72	0.935	0.52*	0.22-1.23	0.05	1.85*	0.63-5.45	0.144
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.04	0.41-2.68	0.910	0.75	0.27-2.06	0.468	0.74*	0.33-1.68	0.344	0.54*	0.24-1.24	0.056
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.51	0.17-1.53	0.113	1.34	0.34-5.27	0.557	0.52*	0.22-1.23	0.050	1.85*	0.63-5.45	0.144
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.14	0.46-2.82	0.716	0.35	0.12-1.02	0.012	0.79*	80.30-2.08	0.532	1.38*	0.46-4,15	0.457
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	0.98	0.29-3.26	0.958	2.00	0.39-10.15	0.272	0.40*	0.13-1.20	0.031	1.07*	0.28-4.09	0.890
More than 5	0.57	0.15-2.23	0.293	2.66	0.52-13.60	0.123	0.53*	0.10-2.74	0.317	1.83*	0.51-6.62	0.227

*the final model was based on univariate relationship

Discussion

To our knowledge this is the first individually linked cohort study to explore changes in susceptibility to smoking, and smoking status, in relation to the removal of tobacco PoS displays from supermarkets and other large retailers in the UK; and hence the first to evaluate the associations between exposure and changes in susceptibility and smoking status before and after the introduction of the ban on PoS displays in supermarkets and other large shops. Our findings suggest that there was a reduction in the proportion of children noticing tobacco PoS displays after the ban was implemented. However, whilst our findings at univariable level suggest that children who noticed PoS displays more often were more likely to become susceptible to smoking and to become smokers, we did not find a statistically significant independent effect once potential confounders were taken into account. In this respect there was no difference in the results we obtained before and after the ban, when associations between main exposures and outcomes were consistently non-significant.

Our study findings are limited by low power arising from the small number of participants for whom linked data from all three surveys were available, and the small number of individuals making the progression to smoking susceptibility or uptake. Due to the fact that some of the schools did not participate in one or more survey waves we were able to link data from only seven out of the initial 11 schools, and linkage proved impossible for many participants as a result of missing or incomplete identity information. Another important limitation is that we were asking children about their exposure to and awareness of PoS displays separately for small shops (corner shops/newsagents and off-licences) and for supermarkets (large shops), but cannot be sure that respondents were able to differentiate these two types of shops. For example, Tesco is typically known as supermarket in the UK but also has local stores which were sufficiently small to be excluded from the 2012 point of sale prohibition. Although we do not have information on compliance with tobacco PoS display ban in large shops in England, recent evidence from Scotland suggest that compliance with ban in small

shops was high [14] and we believe it would be generalizable to first stage of PoS display ban in English settings.

We measured changes in susceptibility and smoking status one year before and one year after the large retailer PoS display ban was implemented in England, and it is possible that a longer period may have had more substantial effects on children's smoking. We selected the measures that to our knowledge were best likely to capture changes in exposure to and awareness of tobacco PoS displays, but it is possible that these measures were insufficiently sensitive to capture immediate effects of the PoS display ban. Although our findings relate to children's smoking, they are consistent with data from Ireland where there was no immediate decrease in general smoking prevalence after implementation of a PoS ban [15]. However, the ban in Ireland led to a reduction in perceived smoking prevalence among young people and adults, suggesting that removal of PoS displays made not smoking easier [15].

Cross-sectional and linked data from earlier waves of this cohort study clearly indicated that exposure to and awareness of tobacco PoS displays was associated with increased risk of becoming susceptible to smoking and also becoming a smoker [9, 10]. Previous studies elsewhere have also consistently suggest that being exposed to tobacco PoS promotion leads to increased likelihood of becoming susceptible to smoking, experimenting with smoking or becoming regular or occasional smoker [16, 17]. Although this tobacco policy is primarily aimed at reducing smoking uptake among children, it appears to have an effect on adult smoking by reducing the number of impulse purchases in jurisdictions where PoS bans are implemented [18]. Evaluation of the Irish tobacco PoS display ban suggested that removal of PoS displays had a potential to de-normalize smoking and young people felt that it could make it easier for them to abstain from smoking uptake [15]. Similarly, in Norway a PoS display ban implemented in 2010 was perceived as a barrier limiting access to tobacco products affecting brand attachment and therefore leading to de-normalization of smoking [19].

Evidence from previous research suggest that the 2012 partial PoS display ban had no immediate effect on smoking prevalence and cigarette consumption among adults, though a steeper reduction in prevalence was observed over the three years following the ban [17]. However, a recent study exploring the effects of PoS display bans in New Zealand suggests that implementation of the ban led to a reduction in initiation, experimentation and regular smoking among young people [20]. Our findings indicate however that whilst prohibition of PoS tobacco displays in large shops in England reduced the proportion of young people reporting exposure to the displays in large and small shops, their removal did not result in a significant reduction in smoking behaviour among young people. Further work is required to determine whether removal of PoS displays in smaller shops, which tend to be the greater source of exposure of young people and which were afforded an exclusion from the English PoS prohibition until April 2015 has yielded a greater effect.

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Contributorship statement

IB was involved in designing the study, collected and analysed the data and drafted the manuscript.

AM contributed substantially to the design of the work and revised and approved the manuscript.

JB contributed substantially to designing the study, was involved in analysis of the data, contributed to drafting the manuscript and approved the manuscript

Competing interests

None

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Data sharing statement

Data available as part of this project will be managed (by UK Centre for Tobacco and Alcohol Studies and shared according to the UKCTAS data management guidelines (available from: http://www.ukctas.ac.uk/ukctas/documents/datamanagement-guidelines.pdf).

Anonymized data used for this study will be available from the main author on request. No additional unpublished data are available.

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Investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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Investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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Abstract

Objective: A prospective evaluation of the effect of 2012 point-of-sale (PoS) display ban in supermarkets in England on perceived exposure to PoS displays, and on changes in susceptibility and smoking uptake among young people.

Design: Cohort study

Settings: Seven schools in Nottinghamshire, England

Participants: 1,035 11-16 year-old schoolchildren

Primary and secondary outcome measures: Changes in reported exposure to PoS displays before and after prohibition, and the association between exposure to and awareness of PoS displays and change in susceptibility to smoking and smoking status between 2011 and 2012 (before the ban) and 2012 and 2013 (after the ban).

Results: The proportion of children noticing tobacco PoS displays in supermarkets most or every time they visited a shop changed little between 2011 and 2012 (59.6% (95% confidence interval 56.6%-62.6%) and 58.8% (95% confidence interval 55.8%- 61.8%), respectively); but decreased by about 13 percentage points to 45.7% (95% confidence interval 42.7%-48.7%) in 2013, after the ban. However, after adjusting for confounders, implementation of the first stage of the PoS ban in 2012 did not result in significant changes in the relation between susceptibility to smoking and smoking status and exposure to and awareness of PoS displays.

Conclusions: Prohibition of PoS in large supermarkets resulted in a decline in the proportion of young people noticing PoS displays in large shops, but little or no change in smoking uptake or susceptibility. It remains to be seen whether extension of the PoS ban to all shops in 2015 has a more marked effect.

Strengths and limitations of this study:

- This is the first individually linked cohort study to investigate changes in exposure to and awareness of tobacco point-of-sale (PoS) displays, and changes in susceptibility to smoking and smoking uptake in relation to first stage of tobacco point-of-sale display ban in England.
- Data were collected using self-administered questionnaires including a wide range of variables: socio-demographic factors, smoking among peers and family, self-perceived academic performance and rebelliousness, smoking status and susceptibility to smoking, exposure to and awareness of tobacco PoS displays, and number of tobacco brands recognised.
- Our findings are limited by low power arising from the relatively small number of participants for whom linked data could be identified.
- Changes in susceptibility to smoking and smoking uptake were investigated one year after the implementation of the ban though longer follow-up time might be required to observe considerable changes in susceptibility as a result of reduced exposure and awareness.

Introduction

Smoking is the largest avoidable cause of death in the UK [1]. Although the prevalence of smoking among adults in Great Britain has declined substantially over recent decades [2] there are still about 9 million smokers in the UK [3], most of whom became smokers before the age of 18 [4]. Although smoking prevalence among young people in Britain has also declined, reaching 8% among 15 year olds in England in 2014, around 207,000 children start smoking every year in the UK [4]. Therefore policies to prevent smoking uptake among young people are of crucial public health importance.

Smoking prevalence has declined in the UK as a result of comprehensive tobacco control policies including legislation prohibiting most forms of tobacco advertising [5]. However until recently in the UK, this legislation provided an exemption for tobacco product displays at the point of sale (PoS). Previous studies have suggested that being exposed to tobacco PoS displays causes adults who intend to quit to make unplanned tobacco purchases [6], and that removal of PoS displays reduces these impulse purchases [7]. Findings from the International Tobacco Control Four Country Survey support these findings, suggesting that PoS display bans reduce exposure to tobacco marketing and the frequency of unplanned purchases of tobacco products [8]. Although there is less evidence on the effect of PoS displays on youth smoking behaviour, we have recently reported data from England suggesting that children with higher levels of exposure to tobacco PoS displays are more likely to be susceptible to smoking [9], and that noticing PoS displays more often was a prospective determinant of the onset of susceptibility (absence of a decision not to smoke) [10]. Being susceptible to smoking is associated with an increased risk of experimentation with smoking, and smoking uptake, among adolescents [11].

In England in April 2012 tobacco PoS displays were banned in all large shops, defined as those with a floor area over 280 square meters [12]. In England, almost all shops of this size are supermarkets, although it should be noted that some supermarket chains also have 'express' outlets which are smaller and hence were not covered by this law. We now report an extension to our earlier work [9,

10] investigating whether this policy has reduced exposure to and awareness of tobacco at PoS among young people, or altered the previously observed relation between exposure to PoS displays and becoming susceptible to smoking or smoking uptake.

Methods

Data collection

Between March and May 2013 we carried out the third in a series of cross-sectional surveys (previously carried out in March-May 2011 and March 2012) of smoking behaviour, exposure to and awareness of PoS displays in students in years 7-11 in Nottinghamshire secondary schools [9, 10]. Informed consent for school participation was obtained from head teachers, and opt-out consent for students by distributing forms to parents of all children in school years 7-11 (aged 11-16). All students whose parents and who themselves did not decline participation were invited to fill in a paper based questionnaire under teacher supervision. Of the 11 schools surveyed in 2011 eight agreed to participate in 2012, and seven of these (and one other school which did not participate in 2012) provided data in 2013. As for this study, we linked data for students in 2011, 2012 and 2013, we were able to link data for all years for these seven schools. Ethics approval for the study was provided by the University of Nottingham School of Education Research Ethics Committee. Further details on data collection are available elsewhere [9, 10].

Variables included

Our questionnaire collected information on demographic variables (age, sex, ethnicity); postcode, which was used to calculate Index for Multiple Deprivation (IMD) quintiles as a measure of socioeconomic status; rebelliousness, self-perceived academic performance, smoking among family members and friends, and whether smoking was allowed in the student's home. As in previous analyses of data from these surveys [9, 10] our main exposure variables were frequency of visiting shops; frequency of noticing PoS displays in these shops; and the number of tobacco brands recognized. Questions about noticing PoS displays and visiting shops were asked separately for small shops and large shops and we looked at the changes in the proportion of children noticing PoS and visiting each type of shops between 2011 and 2012, and 2012 and 2013. Frequency of visiting shops

was coded as a binary variable with two categories: at least two or three times a week, and less than two or three times a week. Frequency of noticing also was coded into binary categories: sometime or less, and most or every time. Number of brands recognized was coded into three distinct categories: none, 1-5 brands, and more than 5 brands. Our main outcome variables were reported changes in susceptibility to smoking defined using previously validated questions by Pierce et al. [11, 13], and change in smoking status from never- to ever-smoker. Further details on the variables included are available in the paper reporting data from the 2011 and 2012 surveys [10]. In this study we investigated changes in children who provided data in all three surveys, and compared changes observed between 2011 and 2012, and between 2012 and 2013, to explore the effects of implementation of the PoS display ban in large shops.

Analysis

We linked data on individual student responses in 2011, 2012 and 2013 using the student's name, school and school year. We explored changes in outcomes between 2011 and 2012 in relation to exposure variables and confounders in 2011 which captures pre-ban data, and then repeated the analysis looking at the changes in susceptibility and smoking status between 2012 and 2013 in relation to exposures in 2012 capturing changes following PoS display ban in large shops. We investigated these changes for small shops and large shops separately. We first investigated whether frequency of noticing PoS displays changed between three study years, and whether these changes differed between small and large shops. We then investigated whether changes in susceptibility to smoking and smoking uptake between 2011 and 2012 were related to exposure to and awareness of tobacco PoS displays in 2011, and whether changes between 2012 and 2013 were related to exposure to and awareness of tobacco PoS displays in 2012 after adjusting for potential confounders. We then compared these results to investigate whether association before and after implementation of PoS display ban in large shops and small shops differed. We used four main outcome variables: 1) the proportion of children who were non-susceptible never smokers in 2011

and 2012 and became susceptible in the following year; 2) the proportion of children who were non-susceptible never smokers in 2011 and 2012 and became smokers in the following year; 3) the proportion of children who were susceptible never smokers and became smokers in subsequent year; and 4) the proportion of children who were susceptible never smokers and reverted to being non-susceptible never smokers between 2011 and 2012, and 2012 and 2013. Students with missing values for outcome variables were excluded from the analysis; missing values for the exposure variables were included in the analysis as a separate category to maximise study power.

As in our previous analyses we used multinomial logistic regression to estimate relative risk ratios (RRRs) for change in susceptibility and smoking status in relation to frequency of visiting shops, frequency of noticing PoS displays, number of brands recognized and variables that combine these. To allow for multiple hypothesis testing we set our statistical significance threshold at a probability of 1%, and calculated 99% confidence intervals (CI). We used a cluster sandwich estimator to account for clustering within classes and schools. Data were analysed using Stata v.11 (Stata Corp. College Station, TX).

Results

From the seven schools participating in the 2011, 2012 and 2013 surveys we received completed questionnaires from 4019, 3989 and 4014 participants, respectively. After excluding children who did not participate in all three years, and those with missing information on outcome variables, a cohort of 1035 children remained for analysis.

Overall, the proportion of children who were non-susceptible never smokers decreased from year to year, from 77.5% in 2011, to 62.8% in 2012 and 55.3% in 2013. On the other hand, the proportion of children who were ever smokers increased considerably from 4.5% in 2011 to 20.7% in 2013. 19.8% of children who were non-susceptible to smoking in 2011 became susceptible in 2012, and 6.0% became ever smokers. Similar transitions were observed between 2012 and 2013 when 18.0% of those non-susceptible to smoking in 2012 became susceptible to smoking in 2013 and 5.2% became ever smokers.

Table 1 displays summary data on a range of smoking and related variables from all three years and demonstrates little change in (for example) deprivation score, parental and sibling smoking, smoking in the family home, academic performance and rebelliousness; but identifies an increase in the number of friends who smoke, consistent with the overall increase in prevalence of ever-smoking within the cohort.

The proportion of children who reported noticing tobacco PoS displays most or every time they visited a supermarket remained stable in 2011 and 2012 (59.6% and 58.8%, respectively) but fell slightly to 45.7% in 2013 after implementation of the PoS display ban in large shops. There was also a small reduction in the proportion of children noticing PoS displays most or every time they visited a small shop, from 74.8% in 2012 to 67.3%% in 2013 though the frequency of visiting shops remained stable (see Table 1).

Table 1: Summary of 2011, 2012 and 2013 data for the 1,035 participants with linked responses

Variable	2011 (number, %)	2012 (number, %)	2013 (number, %)
Sex			
Boy	503 (48.6)	503 (48.6)	503 (48.6)
Girl	532 (51.4)	532 (51.4)	532 (51.4)
Age			
11	147 (14.2)		
12	416 (40.2)	147 (14.2)	
13	379 (36.6)	434 (41.9)	105 (10.1)
14	90 (8.7)	365 (35.3)	406 (39.2)
15		88 (8.5)	420 (40.6)
16			101 (9.8)
Missing	3 (0.3)	1 (0.1)	3 (0.3)
Deprivation quintile			
1(least deprived)	314 (30.3)	338 (32.7)	287 (27.6)
2	107 (10.3)	115 (11.1)	101 (9.7)
3	180 (17.4)	201 (19.4)	165 (15.9)
4	157 (15.2)	181 (17.5)	160 (15.4)
5 (most deprived)	132 (12.8)	151 (14.6)	130 (12.5)
Missing	145 (14.0)	49 (4.7)	197 (18.9)
Parental smoking			
Neither parent smokes	743 (71.8)	749 (72.4)	758 (73.2)
One parent smokes	192 (18.6)	188 (18.2)	202 (19.5)
Both parents smoke	90 (8.7)	76 (7.3)	71 (6.9)
Missing	10 (1.0)	22 (2.1)	4 (0.4)
Sibling smoking			
None smokes	963 (92.6)	928 (89.2)	934 (89.8)
At least one smokes	67 (6.4)	90 (8.7)	101 (9.7)
Missing	10 (1.0)	22 (2.1)	5 (0.5)
Smoking in the main family home			
Not allowed	870 (84.1)	893 (86.3)	896 (86.6)
Allowed	155 (15.0)	121 (11.7)	134 (13.0)
Missing	10 (1.0)	21 (2.0)	5 (0.5)
Number of smoking friends			
None	618 (59.7)	368 (35.6)	306 (29.6)
One or two	115 (11.1)	153 (14.8)	181 (17.5)
Three or more	94 (9.1)	233 (22.5)	290 (28.2)
Not sure	196 (19.0)	258 (24.9)	250 (24.2)
Missing	12 (1.2)	23 (2.2)	8 (0.8)
Self-perceived academic performance			
Excellent or good	830 (80.2)	794 (76.7)	781 (75.5)
Average or below average	185 (17.9)	220 (21.3)	249 (24.1)
Missing	20 (1.9)	21 (2.0)	5 (0.5)
Rebelliousness			
Low	592 (57.2)	593 (57.3)	619 (59.8)
High	420 (40.6)	395 (38.2)	390 (37.7)
Missing	23 (2.2)	47 (4.5)	26 (2.5)
Susceptibility to smoking			
Non susceptible never smoker	802 (77.5)	650 (62.8)	572 (55.3)
Susceptible never smoker	186 (18.0)	250 (24.2)	249 (24.1)
Ever smoker	47 (4.5)	135 (13.0)	214 (20.7)
Notice cigarettes on displays in large shops			
Sometimes or less	401 (38.7)	388 (37.5)	524 (50.6)
Most times or every time	617 (59.6)	609 (58.8)	473 (45.7)
Missing	17 (1.6)	38 (3.7)	38 (3.7)
Notice cigarettes on displays in small shops			
Sometimes or less	259 (25.0)	210 (20.3)	290 (28.0)
Most times or every time	745 (72.0)	774 (74.8)	697 (67.3)
Missing	31 (3.0)	51 (4.9)	48 (4.6)
Frequency of visiting large shops			
Less than 2 or 3 times a week	360 (34.8)	356 (34.4)	344 (33.2)
At least 2 or 3 times a week	667 (64.4)	669 (64.6)	689 (66.6)
Missing	8 (0.8)	10 (1.0)	2 (0.2)
Frequency of visiting small shops			
Less than 2 or 3 times a week	485 (46.9)	493 (47.6)	435 (42.0)

At least 2 or 3 times a week	540 (52.2)	535 (51.7)	598 (57.8)
Missing	10 (1.0)	7 (0.7)	2 (0.2)
Number of brands recognized			
None	282 (27.3)	232 (22.4)	227 (21.9)
1 to 5 brands	381 (36.8)	362 (35.0)	365 (35.3)
More than 5 brands	239 (23.1)	346 (33.4)	356 (34.4)
Missing	133 (12.9)	95 (9.2)	87 (8.4)

Changes in smoking susceptibility and status in relation to exposure variables at univariable level

Analysis at univariable level suggested that among those who were non-susceptible to smoking in 2011 the risk of becoming susceptible to smoking in 2012 was higher among older students with lower levels of self-perceived academic performance, higher levels of rebelliousness, visited large shops less frequently, but recognized a higher number of brands (Table 2). The risk of becoming susceptible to smoking in 2013 among non-susceptible never smokers in 2012 was higher among students who visited large shops less frequently, among those living in homes where smoking was allowed , and those who recognized a higher number of tobacco brands (Table 3).

An increased risk of becoming an ever smoker in 2012 among those who were non-susceptible never smokers in 2011 was associated with age, both parents being smokers, greater number of smoking friends, noticing PoS displays in small shops more often, recognizing greater number of tobacco brands and lower frequency of visiting small shops. Among those who were non-susceptible to smoking in 2012, the risk of becoming an ever smoker in 2013 was higher among children with a greater number of smoking friends, for whom smoking was allowed in their main home, those with lower levels of self-perceived academic performance and those who visited large shops less frequently.

Among children who were susceptible to smoking in 2011, the risk of becoming an ever smoker was higher among children with smoking parents and siblings and greater number of smoking friends, though among those who were susceptible to smoking in 2012 the risk of becoming an ever smoker in 2013 was associated with having smoking siblings and visiting both large and small shops less frequently (Table 3).

Table 2: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables 2011-2012

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Age												
11	1.00			1.00			1.00			1.00		
12	0.90	0.40-2.03	0.746	2.62	0.55-12.51	0.114	0.87	0.17-4.53	0.829	0.46	0.14-1.57	0.105
13	0.97	0.49-1.91	0.894	5.94	1.33-26.49	0.002	0.31	0.07-1.36	0.041	0.74	0.36-1.50	0.271
14	1.03	0.51-2.10	0.908	9.29	1.49-57.78	0.002	0.62	0.27-1.43	0.137	0.98	0.37-2.62	0.968
15												
Parental smoking												
Neither parent smokes	1.00			1.00			1.00			1.00		
One parent smokes	1.73	0.99-3.04	0.011	2.94	0.83-10.43	0.028	1.84	0.61-5.59	0.158	2.68	1.27-5.64	0.001
Both parents smoke	1.37	0.48-3.96	0.441	3.29	1.06-10.24	0.007	1.17	0.22-6.27	0.814	2.61	1.78-5.77	0.002
Sibling smoking												
None smokes	1.00			1.00			1.00			1.00		
At least one smokes	1.57	0.51-4.86	0.303	2.42	0.62-9.53	0.096	1.38	0.33-5.80	0.568	3.77	1.10-12.84	0.005
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	1.63	0.81-3.27	0.073	4.51	2.69-7.56	<0.001	1.23	0.33-4.56	0.683	1.20	0.31-4.72	0.727
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.97	0.80-4.87	0.055	2.85	0.58-14.07	0.090	0.58	0.10-3.44	0.415	1.03	0.24-4.39	0.961
Three or more	2.32	0.70-7.68	0.069	8.23	4.32-15.65	<0.001	0.41	0.05-3.36	0.276	2.67	1.06-6.73	0.006
Not sure	1.66	1.07-2.60	0.003	3.12	0.94-10.32	0.014	0.62	0.24-1.61	0.129	1.16	0.52-2.58	0.641
Self-perceived academic performance												
Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	2.03	1.04-3.94	0.006	1.90	0.92-3.92	0.023	0.53	0.21-1.31	0.070	0.81	0.42-1.56	0.413
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.73	1.27-2.35	<0.001	3.78	2.78-5.14	<0.001	0.87	0.55-1.39	0.452	2.17	0.63-7.51	0.107
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.37	0.95-1.96	0.027	3.17	0.92-10.93	0.017	0.97	0.50-1.90	0.911	0.95	0.49-1.85	0.850
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		

At least 2 or 3 times a week	0.58	0.43-0.78	<0.001	0.63	0.31-1.25	0.080	1.03	0.57-1.86	0.906	0.73	0.40-1.35	0.193
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.23	0.93-1.63	0.062	2.42	1.17-5.00	0.002	0.66	0.20-2.22	0.377	1.39	0.63-3.08	0.279
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.93	0.73-1.18	0.433	0.36	0.29-0.46	<0.001	1.01	0.56-1.84	0.950	0.37	0.12-1.11	0.020
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.64	0.87-3.08	0.044	2.24	0.91-5.53	0.021	0.98	0.25-3.82	0.976	2.05	0.71-5.94	0.081
More than 5	2.67	1.65-4.33	<0.001	6.07	2.38-15.46	<0.001	0.60	0.20-1.78	0.227	2.78	0.75-10.32	0.044

*Sex and Quintiles of Index of Multiple Deprivation not presented as was not a significant predictor for any of the outcome variables

Table 3: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables 2012- 2013

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	2.00	1.11-3.60	0.002	4.11	1.05-16.14	0.008	1.18	0.20-6.84	0.813	1.85	0.68-4.99	0.111
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.51	0.73-3.11	0.144	1.94	0.89-4.26	0.029	0.75	0.17-3.30	0.623	2.48	0.36-17.08	0.225
Three or more	1.67	0.65-4.26	0.161	6.38	1.63-25.04	<0.001	0.57	0.15-2.15	0.278	3.09	0.43-22.11	0.140
Not sure	1.14	0.60-2.14	0.604	2.55	1.05-6.21	0.007	0.57	0.24-1.35	0.090	2.43	0.37-16.01	0.226
Self-perceived academic performance												
Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	1.03	0.48-2.22	0.923	2.11	1.03-4.33	0.007	1.40	0.87-2.27	0.070	1.40	0.68-2.89	0.230
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.89	0.77-4.65	0.068	2.82	0.99-7.99	0.011	1.09	0.59-2.04	0.710	1.48	0.64-3.47	0.230
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.79	0.52-1.18	0.128	1.01	0.43-2.38	0.966	0.52	0.33-0.81	<0.001	1.85	0.72-4.72	0.093
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.56	0.33-0.96	0.005	0.41	0.17-0.97	0.008	0.74	0.39-1.40	0.226	0.54	0.32-0.93	0.003
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.80	0.42-1.54	0.383	0.89	0.36-2.20	0.736	0.79	0.25-2.52	0.603	1.38	0.37-5.12	0.532
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.01	0.61-1.68	0.952	0.36	0.11-1.17	0.025	0.90	0.27-3.03	0.829	0.23	0.09-0.55	<0.001
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.20	0.69-2.09	0.406	1.14	0.34-3.79	0.781	0.40	0.15-1.07	0.016	1.07	0.38-3.04	0.859
More than 5	1.81	1.29-2.54	<0.001	2.02	0.50-8.14	0.195	0.53	0.12-2.25	0.256	1.83	0.59-5.69	0.170

*Sex, Age, Quintiles of Index of Multiple Deprivation, Parental smoking and Sibling smoking not presented as was not a significant predictor for any of the outcome variables

Changes in smoking susceptibility and status in relation to exposure variables at multivariable level

In a multivariable analysis with adjustment for confounding by age, sex, deprivation, parental smoking, sibling smoking, smoking in the main family home, number of smoking friends, self-perceived academic performance and rebelliousness, the risk of becoming susceptible to smoking in 2012 among those who were non-susceptible never smokers in 2011 was unrelated to main exposure variables (frequency of visiting small and large shops and frequency of noticing PoS displays in large and small shops) though recognizing five or more tobacco brands was associated with a two-fold risk of becoming susceptible in 2012 (Table 4). However, none of the exposure variables were related to becoming susceptible in 2013 among children who were non-susceptible to smoking in 2012 Similarly, exposure variables other than recognizing more than five tobacco brands in 2011 were unrelated to becoming a smoker among children who were non-susceptible never smokers in 2011 and 2012. Also, none of the main exposure variables were related to becoming a smoker either in 2012 or 2013 among children who were susceptible to smoking in 2011 and 2012 (Table 5).

Table 4: Adjusted relative risk ratios for changes in susceptibility in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised between 2011-2012 and 2012-2013

	Among non-susceptible never-smokers at baseline 2011-2012						Among non-susceptible never-smokers at baseline 2012-2013					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.31	0.81-2.12	0.153	2.72	1.00-7.40	0.010	0.79	0.45-1.36	0.254	0.98	0.38-2.50	0.954
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.62	0.38-1.01	0.011	0.76	0.33-1.75	0.394	0.61	0.34-1.07	0.023	0.48	0.18-1.22	0.043
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.19	0.70-2.03	0.391	2.27	0.76-6.85	0.055	0.76	0.40-1.44	0.269	0.81	0.27-2.43	0.618
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.00	0.62-1.61	0.994	0.44	0.19-1.02	0.012	1.12	0.64-1.95	0.601	0.42	0.16-1.12	0.023
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.61	0.85-3.02	0.054	2.11	0.64-6.96	0.106	1.18	0.58-2.40	0.555	1.06	0.31-3.60	0.908
More than 5	2.49	1.23-5.02	0.001	4.96	1.51-16.34	0.001	1.60	0.75-3.44	0.110	1.47	0.41-5.29	0.437

Table 5: Adjusted relative risk ratios for changes in susceptibility in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised between 2011-2012 and 2012-2013

	Among susceptible never-smokers at baseline 2011-2012						Among susceptible never-smokers at baseline 2012-2013					
	RRR of becoming non-susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.84	0.32-2.18	0.635	0.97	0.34-2.72	0.935	0.52*	0.22-1.23	0.05	1.85*	0.63-5.45	0.144
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.04	0.41-2.68	0.910	0.75	0.27-2.06	0.468	0.74*	0.33-1.68	0.344	0.54*	0.24-1.24	0.056
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.51	0.17-1.53	0.113	1.34	0.34-5.27	0.557	0.52*	0.22-1.23	0.050	1.85*	0.63-5.45	0.144
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.14	0.46-2.82	0.716	0.35	0.12-1.02	0.012	0.79*	80.30-2.08	0.532	1.38*	0.46-4,15	0.457
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	0.98	0.29-3.26	0.958	2.00	0.39-10.15	0.272	0.40*	0.13-1.20	0.031	1.07*	0.28-4.09	0.890
More than 5	0.57	0.15-2.23	0.293	2.66	0.52-13.60	0.123	0.53*	0.10-2.74	0.317	1.83*	0.51-6.62	0.227

*the final model was based on univariate relationship

Discussion

To our knowledge this is the first individually linked cohort study to explore changes in susceptibility to smoking, and smoking status, in relation to the removal of tobacco PoS displays from supermarkets and other large retailers in the UK; and hence the first to evaluate the associations between exposure and changes in susceptibility and smoking status before and after the introduction of the ban on PoS displays in supermarkets and other large shops. Our findings suggest that there was a reduction in the proportion of children noticing tobacco PoS displays after the ban was implemented. However, whilst our findings at univariable level suggest that children who noticed PoS displays more often were more likely to become susceptible to smoking and to become smokers, we did not find a statistically significant independent effect once potential confounders were taken into account. In this respect there was no difference in the results we obtained before and after the ban, when associations between main exposures and outcomes were consistently non-significant.

Our study findings are limited by low power arising from the small number of participants for whom linked data from all three surveys were available, and the small number of individuals making the progression to smoking susceptibility or uptake. Also, the fact that the cohort ages over study period makes it difficult to assess whether smoking uptake rates have changes as a response to the implementation of the first stage of tobacco PoS display ban. Due to the fact that some of the schools did not participate in one or more survey waves we were able to link data from only seven out of the initial 11 schools, and linkage proved impossible for many participants as a result of missing or incomplete identity information. However, characteristics of the children who we were able to link for all three years were not different from those that were considered for 2011 and 2012 analysis and can be regarded as representative to the cohort. Another important limitation is that we were asking children about their exposure to and awareness of PoS displays separately for small shops (corner shops/newsagents and off-licences) and for supermarkets (large shops), but cannot be

sure that respondents were able to differentiate these two types of shops. For example, Tesco is typically known as supermarket in the UK but also has local stores which were sufficiently small to be excluded from the 2012 point of sale prohibition. Although we do not have information on compliance with tobacco PoS display ban in large shops in England, recent evidence from Scotland suggest that compliance with ban in small shops was high [14] and we believe it would be generalizable to first stage of PoS display ban in English settings.

We measured changes in susceptibility and smoking status one year before and one year after the large retailer PoS display ban was implemented in England, and it is possible that a longer period may have had more substantial effects on children's smoking. We selected the measures that to our knowledge were best likely to capture changes in exposure to and awareness of tobacco PoS displays, but it is possible that these measures were insufficiently sensitive to capture immediate effects of the PoS display ban. Although our findings relate to children's smoking, they are consistent with data from Ireland where there was no immediate decrease in general smoking prevalence after implementation of a PoS ban [15]. However, the ban in Ireland led to a reduction in perceived smoking prevalence among young people and adults, suggesting that removal of PoS displays made not smoking easier [15].

Cross-sectional and linked data from earlier waves of this cohort study clearly indicated that exposure to and awareness of tobacco PoS displays was associated with increased risk of becoming susceptible to smoking and also becoming a smoker [9, 10]. Previous studies elsewhere have also consistently suggest that being exposed to tobacco PoS promotion leads to increased likelihood of becoming susceptible to smoking, experimenting with smoking or becoming regular or occasional smoker [16, 17]. Although this tobacco policy is primarily aimed at reducing smoking uptake among children, it appears to have an effect on adult smoking by reducing the number of impulse purchases in jurisdictions where PoS bans are implemented [18]. Evaluation of the Irish tobacco PoS display ban suggested that removal of PoS displays had a potential to de-normalize smoking and young

people felt that it could make it easier for them to abstain from smoking uptake [15]. Similarly, in Norway a PoS display ban implemented in 2010 was perceived as a barrier limiting access to tobacco products affecting brand attachment and therefore leading to de-normalization of smoking [19].

Evidence from previous research suggest that the 2012 partial PoS display ban had no immediate effect on smoking prevalence and cigarette consumption among adults, though a steeper reduction in prevalence was observed over the three years following the ban [17]. However, a recent study exploring the effects of PoS display bans in New Zealand suggests that implementation of the ban led to a reduction in initiation, experimentation and regular smoking among young people [20]. Our findings indicate however that whilst prohibition of PoS tobacco displays in large shops in England reduced the proportion of young people reporting exposure to the displays in large and small shops, their removal did not result in a significant reduction in smoking behaviour among young people. Further work is required to determine whether removal of PoS displays in smaller shops, which tend to be the greater source of exposure of young people and which were afforded an exclusion from the English PoS prohibition until April 2015 has yielded a greater effect.

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Contributorship statement

IB was involved in designing the study, collected and analysed the data and drafted the manuscript.

AM contributed substantially to the design of the work and revised and approved the manuscript.

JB contributed substantially to designing the study, was involved in analysis of the data, contributed to drafting the manuscript and approved the manuscript

Competing interests

None

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Data sharing statement

Data available as part of this project will be managed (by UK Centre for Tobacco and Alcohol Studies and shared according to the UKCTAS data management guidelines (available from: http://www.ukctas.ac.uk/ukctas/documents/datamanagement-guidelines.pdf).

Anonymized data used for this study will be available from the main author on request. No additional unpublished data are available.

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A cohort study investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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A cohort study investigating the effects of first stage of the English tobacco point-of-sale display ban on awareness, susceptibility and smoking uptake among adolescents

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Abstract

Objective: A prospective evaluation of the effect of 2012 point-of-sale (PoS) display ban in supermarkets in England on perceived exposure to PoS displays, and on changes in susceptibility and smoking uptake among young people.

Design: Cohort study

Settings: Seven schools in Nottinghamshire, England

Participants: 1,035 11-16 year-old schoolchildren

Primary and secondary outcome measures: Changes in reported exposure to PoS displays before and after prohibition, and the association between exposure to and awareness of PoS displays and change in susceptibility to smoking and smoking status between 2011 and 2012 (before the ban) and 2012 and 2013 (after the ban).

Results: The proportion of children noticing tobacco PoS displays in supermarkets most or every time they visited a shop changed little between 2011 and 2012 (59.6% (95% confidence interval 56.6%-62.6%) and 58.8% (95% confidence interval 55.8%- 61.8%), respectively); but decreased by about 13 percentage points to 45.7% (95% confidence interval 42.7%-48.7%) in 2013, after the ban. However, after adjusting for confounders, implementation of the first stage of the PoS ban in 2012 did not result in significant changes in the relation between susceptibility to smoking and smoking status and exposure to and awareness of PoS displays.

Conclusions: Prohibition of PoS in large supermarkets resulted in a decline in the proportion of young people noticing PoS displays in large shops, but little or no change in smoking uptake or susceptibility. It remains to be seen whether extension of the PoS ban to all shops in 2015 has a more marked effect.

Strengths and limitations of this study:

- This is the first individually linked cohort study to investigate changes in exposure to and awareness of tobacco point-of-sale (PoS) displays, and changes in susceptibility to smoking and smoking uptake in relation to first stage of tobacco point-of-sale display ban in England.
- Data were collected using self-administered questionnaires including a wide range of variables: socio-demographic factors, smoking among peers and family, self-perceived academic performance and rebelliousness, smoking status and susceptibility to smoking, exposure to and awareness of tobacco PoS displays, and number of tobacco brands recognised.
- Our findings are limited by low power arising from the relatively small number of participants for whom linked data could be identified.
- Changes in susceptibility to smoking and smoking uptake were investigated one year after the implementation of the ban though longer follow-up time might be required to observe considerable changes in susceptibility as a result of reduced exposure and awareness.

Introduction

Smoking is the largest avoidable cause of death in the UK [1]. Although the prevalence of smoking among adults in Great Britain has declined substantially over recent decades [2] there are still about 9 million smokers in the UK [3], most of whom became smokers before the age of 18 [4]. Although smoking prevalence among young people in Britain has also declined, reaching 8% among 15 year olds in England in 2014, around 207,000 children start smoking every year in the UK [4]. Therefore policies to prevent smoking uptake among young people are of crucial public health importance.

Smoking prevalence has declined in the UK as a result of comprehensive tobacco control policies including legislation prohibiting most forms of tobacco advertising [5]. However until recently in the UK, this legislation provided an exemption for tobacco product displays at the point of sale (PoS). Previous studies have suggested that being exposed to tobacco PoS displays causes adults who intend to quit to make unplanned tobacco purchases [6], and that removal of PoS displays reduces these impulse purchases [7]. Findings from the International Tobacco Control Four Country Survey support these findings, suggesting that PoS display bans reduce exposure to tobacco marketing and the frequency of unplanned purchases of tobacco products [8]. Although there is less evidence on the effect of PoS displays on youth smoking behaviour, we have recently reported data from England suggesting that children with higher levels of exposure to tobacco PoS displays are more likely to be susceptible to smoking [9], and that noticing PoS displays more often was a prospective determinant of the onset of susceptibility (absence of a decision not to smoke) [10]. Being susceptible to smoking is associated with an increased risk of experimentation with smoking, and smoking uptake, among adolescents [11].

In England in April 2012 tobacco PoS displays were banned in all large shops, defined as those with a floor area over 280 square meters [[12] We now report an extension to our earlier work [9, 10] investigating whether this policy has reduced exposure to and awareness of tobacco at PoS among young people, or altered the previously observed relation between exposure to PoS displays and

becoming susceptible to smoking or smoking uptake.

Methods

Data collection

Between March and May 2013 we carried out the third in a series of cross-sectional surveys (previously carried out in March-May 2011 and March 2012) of smoking behaviour, exposure to and awareness of PoS displays in students in years 7-11 in Nottinghamshire secondary schools [9, 10]. Informed consent for school participation was obtained from head teachers, and opt-out consent for students by distributing forms to parents of all children in school years 7-11 (aged 11-16). All students whose parents and who themselves did not decline participation were invited to fill in a paper based questionnaire under teacher supervision. Of the 11 schools surveyed in 2011 eight agreed to participate in 2012, and seven of these (and one other school which did not participate in 2012) provided data in 2013. As for this study, we linked data for students in 2011, 2012 and 2013, we were able to link data for all years for these seven schools. Ethics approval for the study was provided by the University of Nottingham School of Education Research Ethics Committee. Further details on data collection are available elsewhere [9, 10].

Variables included

Our questionnaire collected information on demographic variables (age, sex, ethnicity); postcode, which was used to calculate Index for Multiple Deprivation (IMD) quintiles as a measure of socioeconomic status; rebelliousness, self-perceived academic performance, smoking among family members and friends, and whether smoking was allowed in the student's home. As in previous analyses of data from these surveys [9, 10] our main exposure variables were frequency of visiting shops; frequency of noticing PoS displays in these shops; and the number of tobacco brands recognized. Questions about noticing PoS displays and visiting shops were asked separately for small shops and large shops and we looked at the changes in the proportion of children noticing PoS and visiting each type of shops between 2011 and 2012, and 2012 and 2013. Frequency of visiting shops

was coded as a binary variable with two categories: at least two or three times a week, and less than two or three times a week. Frequency of noticing also was coded into binary categories: sometime or less, and most or every time. Number of brands recognized was coded into three distinct categories: none, 1-5 brands, and more than 5 brands. Our main outcome variables were reported changes in susceptibility to smoking defined using previously validated questions by Pierce et al. [11, 13], and change in smoking status from never- to ever-smoker. Further details on the variables included are available in the paper reporting data from the 2011 and 2012 surveys [10]. In this study we investigated changes in children who provided data in all three surveys, and compared changes observed between 2011 and 2012, and between 2012 and 2013, to explore the effects of implementation of the PoS display ban in large shops.

Analysis

We linked data on individual student responses in 2011, 2012 and 2013 using the student's name, school and school year. We explored changes in outcomes between 2011 and 2012 in relation to exposure variables and confounders in 2011 which captures pre-ban data, and then repeated the analysis looking at the changes in susceptibility and smoking status between 2012 and 2013 in relation to exposures in 2012 capturing changes following PoS display ban in large shops. We investigated these changes for small shops and large shops separately. We first investigated whether frequency of noticing PoS displays changed between three study years, and whether these changes differed between small and large shops. We then investigated whether changes in susceptibility to smoking and smoking uptake between 2011 and 2012 were related to exposure to and awareness of tobacco PoS displays in 2011, and whether changes between 2012 and 2013 were related to exposure to and awareness of tobacco PoS displays in 2012 after adjusting for potential confounders. We then compared these results to investigate whether association before and after implementation of PoS display ban in large shops and small shops differed. We used four main outcome variables: 1) the proportion of children who were non-susceptible never smokers in 2011

and 2012 and became susceptible in the following year; 2) the proportion of children who were non-susceptible never smokers in 2011 and 2012 and became smokers in the following year; 3) the proportion of children who were susceptible never smokers and became smokers in subsequent year; and 4) the proportion of children who were susceptible never smokers and reverted to being non-susceptible never smokers between 2011 and 2012, and 2012 and 2013. Students with missing values for outcome variables were excluded from the analysis; missing values for the exposure variables were included in the analysis as a separate category to maximise study power.

As in our previous analyses we used multinomial logistic regression to estimate relative risk ratios (RRRs) for change in susceptibility and smoking status in relation to frequency of visiting shops, frequency of noticing PoS displays, number of brands recognized and variables that combine these. To allow for multiple hypothesis testing we set our statistical significance threshold at a probability of 1%, and calculated 99% confidence intervals (CI). We used a cluster sandwich estimator to account for clustering within classes and schools. Data were analysed using Stata v.11 (Stata Corp. College Station, TX).

Results

From the seven schools participating in the 2011, 2012 and 2013 surveys we received completed questionnaires from 4019, 3989 and 4014 participants, respectively. After excluding children who did not participate in all three years, and those with missing information on outcome variables, a cohort of 1035 children remained for analysis.

Overall, the proportion of children who were non-susceptible never smokers decreased from year to year, from 77.5% in 2011, to 62.8% in 2012 and 55.3% in 2013. On the other hand, the proportion of children who were ever smokers increased considerably from 4.5% in 2011 to 20.7% in 2013. 19.8% of children who were non-susceptible to smoking in 2011 became susceptible in 2012, and 6.0% became ever smokers. Similar transitions were observed between 2012 and 2013 when 18.0% of those non-susceptible to smoking in 2012 became susceptible to smoking in 2013 and 5.2% became ever smokers.

Table 1 displays summary data on a range of smoking and related variables from all three years and demonstrates little change in (for example) deprivation score, parental and sibling smoking, smoking in the family home, academic performance and rebelliousness; but identifies an increase in the number of friends who smoke, consistent with the overall increase in prevalence of ever-smoking within the cohort.

The proportion of children who reported noticing tobacco PoS displays most or every time they visited a supermarket remained stable in 2011 and 2012 (59.6% and 58.8%, respectively) but fell slightly to 45.7% in 2013 after implementation of the PoS display ban in large shops. There was also a small reduction in the proportion of children noticing PoS displays most or every time they visited a small shop, from 74.8% in 2012 to 67.3%% in 2013 though the frequency of visiting shops remained stable (see Table 1).

Table 1: Summary of 2011, 2012 and 2013 data for the 1,035 participants with linked responses

Variable	2011 (number, %)	2012 (number, %)	2013 (number, %)
Sex			
Boy	503 (48.6)	503 (48.6)	503 (48.6)
Girl	532 (51.4)	532 (51.4)	532 (51.4)
Age			
11	147 (14.2)		
12	416 (40.2)	147 (14.2)	
13	379 (36.6)	434 (41.9)	105 (10.1)
14	90 (8.7)	365 (35.3)	406 (39.2)
15		88 (8.5)	420 (40.6)
16			101 (9.8)
Missing	3 (0.3)	1 (0.1)	3 (0.3)
Deprivation quintile			
1(least deprived)	314 (30.3)	338 (32.7)	287 (27.6)
2	107 (10.3)	115 (11.1)	101 (9.7)
3	180 (17.4)	201 (19.4)	165 (15.9)
4	157 (15.2)	181 (17.5)	160 (15.4)
5 (most deprived)	132 (12.8)	151 (14.6)	130 (12.5)
Missing	145 (14.0)	49 (4.7)	197 (18.9)
Parental smoking			
Neither parent smokes	743 (71.8)	749 (72.4)	758 (73.2)
One parent smokes	192 (18.6)	188 (18.2)	202 (19.5)
Both parents smoke	90 (8.7)	76 (7.3)	71 (6.9)
Missing	10 (1.0)	22 (2.1)	4 (0.4)
Sibling smoking			
None smokes	963 (92.6)	928 (89.2)	934 (89.8)
At least one smokes	67 (6.4)	90 (8.7)	101 (9.7)
Missing	10 (1.0)	22 (2.1)	5 (0.5)
Smoking in the main family home			
Not allowed	870 (84.1)	893 (86.3)	896 (86.6)
Allowed	155 (15.0)	121 (11.7)	134 (13.0)
Missing	10 (1.0)	21 (2.0)	5 (0.5)
Number of smoking friends			
None	618 (59.7)	368 (35.6)	306 (29.6)
One or two	115 (11.1)	153 (14.8)	181 (17.5)
Three or more	94 (9.1)	233 (22.5)	290 (28.2)
Not sure	196 (19.0)	258 (24.9)	250 (24.2)
Missing	12 (1.2)	23 (2.2)	8 (0.8)
Self-perceived academic performance			
Excellent or good	830 (80.2)	794 (76.7)	781 (75.5)
Average or below average	185 (17.9)	220 (21.3)	249 (24.1)
Missing	20 (1.9)	21 (2.0)	5 (0.5)
Rebelliousness			
Low	592 (57.2)	593 (57.3)	619 (59.8)
High	420 (40.6)	395 (38.2)	390 (37.7)
Missing	23 (2.2)	47 (4.5)	26 (2.5)
Susceptibility to smoking			
Non susceptible never smoker	802 (77.5)	650 (62.8)	572 (55.3)
Susceptible never smoker	186 (18.0)	250 (24.2)	249 (24.1)
Ever smoker	47 (4.5)	135 (13.0)	214 (20.7)
Notice cigarettes on displays in large shops			
Sometimes or less	401 (38.7)	388 (37.5)	524 (50.6)
Most times or every time	617 (59.6)	609 (58.8)	473 (45.7)
Missing	17 (1.6)	38 (3.7)	38 (3.7)
Notice cigarettes on displays in small shops			
Sometimes or less	259 (25.0)	210 (20.3)	290 (28.0)
Most times or every time	745 (72.0)	774 (74.8)	697 (67.3)
Missing	31 (3.0)	51 (4.9)	48 (4.6)
Frequency of visiting large shops			
Less than 2 or 3 times a week	360 (34.8)	356 (34.4)	344 (33.2)
At least 2 or 3 times a week	667 (64.4)	669 (64.6)	689 (66.6)
Missing	8 (0.8)	10 (1.0)	2 (0.2)
Frequency of visiting small shops			
Less than 2 or 3 times a week	485 (46.9)	493 (47.6)	435 (42.0)

At least 2 or 3 times a week	540 (52.2)	535 (51.7)	598 (57.8)
Missing	10 (1.0)	7 (0.7)	2 (0.2)
Number of brands recognized			
None	282 (27.3)	232 (22.4)	227 (21.9)
1 to 5 brands	381 (36.8)	362 (35.0)	365 (35.3)
More than 5 brands	239 (23.1)	346 (33.4)	356 (34.4)
Missing	133 (12.9)	95 (9.2)	87 (8.4)

Changes in smoking susceptibility and status in relation to exposure variables at univariable level

Analysis at univariable level suggested that among those who were non-susceptible to smoking in 2011 the risk of becoming susceptible to smoking in 2012 was higher among older students with lower levels of self-perceived academic performance, higher levels of rebelliousness, visited large shops less frequently, but recognized a higher number of brands (Table 2). The risk of becoming susceptible to smoking in 2013 among non-susceptible never smokers in 2012 was higher among students who visited large shops less frequently, among those living in homes where smoking was allowed , and those who recognized a higher number of tobacco brands (Table 3).

An increased risk of becoming an ever smoker in 2012 among those who were non-susceptible never smokers in 2011 was associated with age, both parents being smokers, greater number of smoking friends, noticing PoS displays in small shops more often, recognizing greater number of tobacco brands and lower frequency of visiting small shops. Among those who were non-susceptible to smoking in 2012, the risk of becoming an ever smoker in 2013 was higher among children with a greater number of smoking friends, for whom smoking was allowed in their main home, those with lower levels of self-perceived academic performance and those who visited large shops less frequently.

Among children who were susceptible to smoking in 2011, the risk of becoming an ever smoker was higher among children with smoking parents and siblings and greater number of smoking friends, though among those who were susceptible to smoking in 2012 the risk of becoming an ever smoker in 2013 was associated with having smoking siblings and visiting both large and small shops less frequently (Table 3).

Table 2: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables 2011-2012

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Age												
11	1.00			1.00			1.00			1.00		
12	0.90	0.40-2.03	0.746	2.62	0.55-12.51	0.114	0.87	0.17-4.53	0.829	0.46	0.14-1.57	0.105
13	0.97	0.49-1.91	0.894	5.94	1.33-26.49	0.002	0.31	0.07-1.36	0.041	0.74	0.36-1.50	0.271
14	1.03	0.51-2.10	0.908	9.29	1.49-57.78	0.002	0.62	0.27-1.43	0.137	0.98	0.37-2.62	0.968
15												
Parental smoking												
Neither parent smokes	1.00			1.00			1.00			1.00		
One parent smokes	1.73	0.99-3.04	0.011	2.94	0.83-10.43	0.028	1.84	0.61-5.59	0.158	2.68	1.27-5.64	0.001
Both parents smoke	1.37	0.48-3.96	0.441	3.29	1.06-10.24	0.007	1.17	0.22-6.27	0.814	2.61	1.78-5.77	0.002
Sibling smoking												
None smokes	1.00			1.00			1.00			1.00		
At least one smokes	1.57	0.51-4.86	0.303	2.42	0.62-9.53	0.096	1.38	0.33-5.80	0.568	3.77	1.10-12.84	0.005
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	1.63	0.81-3.27	0.073	4.51	2.69-7.56	<0.001	1.23	0.33-4.56	0.683	1.20	0.31-4.72	0.727
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.97	0.80-4.87	0.055	2.85	0.58-14.07	0.090	0.58	0.10-3.44	0.415	1.03	0.24-4.39	0.961
Three or more	2.32	0.70-7.68	0.069	8.23	4.32-15.65	<0.001	0.41	0.05-3.36	0.276	2.67	1.06-6.73	0.006
Not sure	1.66	1.07-2.60	0.003	3.12	0.94-10.32	0.014	0.62	0.24-1.61	0.129	1.16	0.52-2.58	0.641
Self-perceived academic performance												
Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	2.03	1.04-3.94	0.006	1.90	0.92-3.92	0.023	0.53	0.21-1.31	0.070	0.81	0.42-1.56	0.413
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.73	1.27-2.35	<0.001	3.78	2.78-5.14	<0.001	0.87	0.55-1.39	0.452	2.17	0.63-7.51	0.107
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.37	0.95-1.96	0.027	3.17	0.92-10.93	0.017	0.97	0.50-1.90	0.911	0.95	0.49-1.85	0.850
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		

At least 2 or 3 times a week	0.58	0.43-0.78	<0.001	0.63	0.31-1.25	0.080	1.03	0.57-1.86	0.906	0.73	0.40-1.35	0.193
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.23	0.93-1.63	0.062	2.42	1.17-5.00	0.002	0.66	0.20-2.22	0.377	1.39	0.63-3.08	0.279
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.93	0.73-1.18	0.433	0.36	0.29-0.46	<0.001	1.01	0.56-1.84	0.950	0.37	0.12-1.11	0.020
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.64	0.87-3.08	0.044	2.24	0.91-5.53	0.021	0.98	0.25-3.82	0.976	2.05	0.71-5.94	0.081
More than 5	2.67	1.65-4.33	<0.001	6.07	2.38-15.46	<0.001	0.60	0.20-1.78	0.227	2.78	0.75-10.32	0.044

*Sex and Quintiles of Index of Multiple Deprivation not presented as was not a significant predictor for any of the outcome variables

Table 3: Unadjusted relative risk ratios for changes in susceptibility and smoking status in relation to explanatory variables 2012- 2013

	Among non-susceptible never-smokers at baseline						Among susceptible never-smokers at baseline					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Smoking in the main family home												
Not allowed	1.00			1.00			1.00			1.00		
Allowed	2.00	1.11-3.60	0.002	4.11	1.05-16.14	0.008	1.18	0.20-6.84	0.813	1.85	0.68-4.99	0.111
Number of friends who smoke												
None	1.00			1.00			1.00			1.00		
One or two	1.51	0.73-3.11	0.144	1.94	0.89-4.26	0.029	0.75	0.17-3.30	0.623	2.48	0.36-17.08	0.225
Three or more	1.67	0.65-4.26	0.161	6.38	1.63-25.04	<0.001	0.57	0.15-2.15	0.278	3.09	0.43-22.11	0.140
Not sure	1.14	0.60-2.14	0.604	2.55	1.05-6.21	0.007	0.57	0.24-1.35	0.090	2.43	0.37-16.01	0.226
Self-perceived academic performance												
Excellent or good	1.00			1.00			1.00			1.00		
Average or below average	1.03	0.48-2.22	0.923	2.11	1.03-4.33	0.007	1.40	0.87-2.27	0.070	1.40	0.68-2.89	0.230
Rebelliousness												
Low	1.00			1.00			1.00			1.00		
High	1.89	0.77-4.65	0.068	2.82	0.99-7.99	0.011	1.09	0.59-2.04	0.710	1.48	0.64-3.47	0.230
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.79	0.52-1.18	0.128	1.01	0.43-2.38	0.966	0.52	0.33-0.81	<0.001	1.85	0.72-4.72	0.093
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.56	0.33-0.96	0.005	0.41	0.17-0.97	0.008	0.74	0.39-1.40	0.226	0.54	0.32-0.93	0.003
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.80	0.42-1.54	0.383	0.89	0.36-2.20	0.736	0.79	0.25-2.52	0.603	1.38	0.37-5.12	0.532
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.01	0.61-1.68	0.952	0.36	0.11-1.17	0.025	0.90	0.27-3.03	0.829	0.23	0.09-0.55	<0.001
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.20	0.69-2.09	0.406	1.14	0.34-3.79	0.781	0.40	0.15-1.07	0.016	1.07	0.38-3.04	0.859
More than 5	1.81	1.29-2.54	<0.001	2.02	0.50-8.14	0.195	0.53	0.12-2.25	0.256	1.83	0.59-5.69	0.170

*Sex, Age, Quintiles of Index of Multiple Deprivation, Parental smoking and Sibling smoking not presented as was not a significant predictor for any of the outcome variables

Changes in smoking susceptibility and status in relation to exposure variables at multivariable level

In a multivariable analysis with adjustment for confounding by age, sex, deprivation, parental smoking, sibling smoking, smoking in the main family home, number of smoking friends, self-perceived academic performance and rebelliousness, the risk of becoming susceptible to smoking in 2012 among those who were non-susceptible never smokers in 2011 was unrelated to main exposure variables (frequency of visiting small and large shops and frequency of noticing PoS displays in large and small shops) though recognizing five or more tobacco brands was associated with a two-fold risk of becoming susceptible in 2012 (Table 4). However, none of the exposure variables were related to becoming susceptible in 2013 among children who were non-susceptible to smoking in 2012 Similarly, exposure variables other than recognizing more than five tobacco brands in 2011 were unrelated to becoming a smoker among children who were non-susceptible never smokers in 2011 and 2012. Also, none of the main exposure variables were related to becoming a smoker either in 2012 or 2013 among children who were susceptible to smoking in 2011 and 2012 (Table 5).

Table 4: Adjusted relative risk ratios for changes in susceptibility in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised between 2011-2012 and 2012-2013

	Among non-susceptible never-smokers at baseline 2011-2012						Among non-susceptible never-smokers at baseline 2012-2013					
	RRR of becoming susceptible			RRR of becoming an ever smoker			RRR of becoming susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.31	0.81-2.12	0.153	2.72	1.00-7.40	0.010	0.79	0.45-1.36	0.254	0.98	0.38-2.50	0.954
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	0.62	0.38-1.01	0.011	0.76	0.33-1.75	0.394	0.61	0.34-1.07	0.023	0.48	0.18-1.22	0.043
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	1.19	0.70-2.03	0.391	2.27	0.76-6.85	0.055	0.76	0.40-1.44	0.269	0.81	0.27-2.43	0.618
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.00	0.62-1.61	0.994	0.44	0.19-1.02	0.012	1.12	0.64-1.95	0.601	0.42	0.16-1.12	0.023
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	1.61	0.85-3.02	0.054	2.11	0.64-6.96	0.106	1.18	0.58-2.40	0.555	1.06	0.31-3.60	0.908
More than 5	2.49	1.23-5.02	0.001	4.96	1.51-16.34	0.001	1.60	0.75-3.44	0.110	1.47	0.41-5.29	0.437

Table 5: Adjusted relative risk ratios for changes in susceptibility in relation to noticing PoS displays, frequency of visiting shops, and number of brands recognised between 2011-2012 and 2012-2013

	Among susceptible never-smokers at baseline 2011-2012						Among susceptible never-smokers at baseline 2012-2013					
	RRR of becoming non-susceptible			RRR of becoming an ever smoker			RRR of becoming non-susceptible			RRR of becoming an ever smoker		
	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p	Estimate	99% CI	p
Noticing point of sale displays in large shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.84	0.32-2.18	0.635	0.97	0.34-2.72	0.935	0.52*	0.22-1.23	0.05	1.85*	0.63-5.45	0.144
Frequency of visiting large shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.04	0.41-2.68	0.910	0.75	0.27-2.06	0.468	0.74*	0.33-1.68	0.344	0.54*	0.24-1.24	0.056
Noticing point of sale displays in small shops												
Sometimes or less	1.00			1.00			1.00			1.00		
Most or every time	0.51	0.17-1.53	0.113	1.34	0.34-5.27	0.557	0.52*	0.22-1.23	0.050	1.85*	0.63-5.45	0.144
Frequency of visiting small shops												
Less than 2 or 3 times a week	1.00			1.00			1.00			1.00		
At least 2 or 3 times a week	1.14	0.46-2.82	0.716	0.35	0.12-1.02	0.012	0.79*	80.30-2.08	0.532	1.38*	0.46-4,15	0.457
Number of brands recognised												
None	1.00			1.00			1.00			1.00		
1 to 5	0.98	0.29-3.26	0.958	2.00	0.39-10.15	0.272	0.40*	0.13-1.20	0.031	1.07*	0.28-4.09	0.890
More than 5	0.57	0.15-2.23	0.293	2.66	0.52-13.60	0.123	0.53*	0.10-2.74	0.317	1.83*	0.51-6.62	0.227

*the final model was based on univariate relationship

Discussion

To our knowledge this is the first individually linked cohort study to explore changes in susceptibility to smoking, and smoking status, in relation to the removal of tobacco PoS displays from supermarkets and other large retailers in the UK; and hence the first to evaluate the associations between exposure and changes in susceptibility and smoking status before and after the introduction of the ban on PoS displays in supermarkets and other large shops. Our findings suggest that there was a reduction in the proportion of children noticing tobacco PoS displays after the ban was implemented. However, whilst our findings at univariable level suggest that children who noticed PoS displays more often were more likely to become susceptible to smoking and to become smokers, we did not find a statistically significant independent effect once potential confounders were taken into account. In this respect there was no difference in the results we obtained before and after the ban, when associations between main exposures and outcomes were consistently non-significant.

Our study findings are limited by low power arising from the small number of participants for whom linked data from all three surveys were available, and the small number of individuals making the progression to smoking susceptibility or uptake. Also, the fact that the cohort ages over study period makes it difficult to assess whether smoking uptake rates have changes as a response to the implementation of the first stage of tobacco PoS display ban. Due to the fact that some of the schools did not participate in one or more survey waves we were able to link data from only seven out of the initial 11 schools, and linkage proved impossible for many participants as a result of missing or incomplete identity information. However, the demographic characteristics of the children we were able to link for all three years were broadly similar, particularly in relation to deprivation, to those of the full original sample of participants in the 2011 survey [9] and of 2012 participants [10]. Another important limitation is that we were asking children about their exposure to and awareness of PoS displays separately for small shops (corner shops/newsagents and off-licences) and for

supermarkets (large shops), but cannot be sure that respondents were able to differentiate these two types of shops. For example, Tesco is typically known as supermarket in the UK but also has local stores which were sufficiently small to be excluded from the 2012 point of sale prohibition. Although we do not have information on compliance with tobacco PoS display ban in large shops in England, recent evidence from Scotland suggest that compliance with ban in small shops was high [14] and we believe it would be generalizable to first stage of PoS display ban in English settings.

We measured changes in susceptibility and smoking status one year before and one year after the large retailer PoS display ban was implemented in England, and it is possible that a longer period may have had more substantial effects on children's smoking. We selected the measures that to our knowledge were best likely to capture changes in exposure to and awareness of tobacco PoS displays, but it is possible that these measures were insufficiently sensitive to capture immediate effects of the PoS display ban. Although our findings relate to children's smoking, they are consistent with data from Ireland where there was no immediate decrease in general smoking prevalence after implementation of a PoS ban [15]. However, the ban in Ireland led to a reduction in perceived smoking prevalence among young people and adults, suggesting that removal of PoS displays made not smoking easier [15].

Cross-sectional and linked data from earlier waves of this cohort study clearly indicated that exposure to and awareness of tobacco PoS displays was associated with increased risk of becoming susceptible to smoking and also becoming a smoker [9, 10]. Previous studies elsewhere have also consistently suggest that being exposed to tobacco PoS promotion leads to increased likelihood of becoming susceptible to smoking, experimenting with smoking or becoming regular or occasional smoker [16, 17]. Although this tobacco policy is primarily aimed at reducing smoking uptake among children, it appears to have an effect on adult smoking by reducing the number of impulse purchases in jurisdictions where PoS bans are implemented [18]. Evaluation of the Irish tobacco PoS display ban suggested that removal of PoS displays had a potential to de-normalize smoking and young

people felt that it could make it easier for them to abstain from smoking uptake [15]. Similarly, in Norway a PoS display ban implemented in 2010 was perceived as a barrier limiting access to tobacco products affecting brand attachment and therefore leading to de-normalization of smoking [19].

Evidence from previous research suggest that the 2012 partial PoS display ban had no immediate effect on smoking prevalence and cigarette consumption among adults, though a steeper reduction in prevalence was observed over the three years following the ban [17]. However, a recent study exploring the effects of PoS display bans in New Zealand suggests that implementation of the ban led to a reduction in initiation, experimentation and regular smoking among young people [20]. Our findings indicate however that whilst prohibition of PoS tobacco displays in large shops in England reduced the proportion of young people reporting exposure to the displays in large and small shops, their removal did not result in a significant reduction in smoking behaviour among young people. Further work is required to determine whether removal of PoS displays in smaller shops, which tend to be the greater source of exposure of young people and which were afforded an exclusion from the English PoS prohibition until April 2015 has yielded a greater effect.

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Contributorship statement

IB was involved in designing the study, collected and analysed the data and drafted the manuscript.

AM contributed substantially to the design of the work and revised and approved the manuscript.

JB contributed substantially to designing the study, was involved in analysis of the data, contributed to drafting the manuscript and approved the manuscript

Competing interests

None

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Data sharing statement

Data available as part of this project will be managed (by UK Centre for Tobacco and Alcohol Studies and shared according to the UKCTAS data management guidelines (available from: http://www.ukctas.ac.uk/ukctas/documents/datamanagement-guidelines.pdf).

Anonymized data used for this study will be available from the main author on request. No additional unpublished data are available.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2	
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5	We now report an extension to our earlier work [9, 10] investigating whether this policy has reduced exposure to and awareness of tobacco at PoS among young people, or altered the previously observed relation between exposure to PoS displays and becoming susceptible to smoking or smoking uptake.
Methods				
Study design	4	Present key elements of study design early in the paper	6	See below
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	Between March and May 2013 we carried out the third in a series of cross-sectional surveys (previously carried out in March-May 2011 and March 2012) of smoking

				behaviour, exposure to and awareness of PoS displays in students in years 7-11 in Nottinghamshire secondary schools [9, 10].
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6	Informed consent for school participation was obtained from head teachers, and opt-out consent for students by distributing forms to parents of all children in school years 7-11 (aged 11-16). All students whose parents and who themselves did not decline participation were invited to fill in a paper based questionnaire under teacher supervision. Of the 11 schools surveyed in 2011 eight agreed to participate in 2012, and seven of these (and one other school which did not participate in 2012) provided data in 2013. As for this study, we linked data for students in 2011, 2012 and 2013, we were able to link data for all years for these seven

			schools.
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	6, 9

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7	*Variables included* Our questionnaire collected information on demographic variables (age, sex, ethnicity); postcode, which was used to calculate Index for Multiple Deprivation (IMD) quintiles as a measure of socioeconomic status; rebelliousness, self-perceived academic performance, smoking among family members and friends, and whether smoking was allowed in the student's home. As in previous analyses of data from these surveys [9, 10] our main exposure variables were frequency of visiting shops; frequency of noticing PoS displays in these shops; and the number of tobacco brands recognized. Questions about noticing PoS displays and visiting shops were asked separately for small shops and large shops and we looked at the changes in the proportion of children noticing PoS and visiting each type of shops between 2011 and 2012, and 2012 and 2013. Frequency of visiting

shops was coded as a binary variable with two categories: at least two or three times a week, and less than two or three times a week. Frequency of noticing also was coded into binary categories: sometime or less, and most or every time. Number of brands recognized was coded into three distinct categories: none, 1-5 brands, and more than 5 brands. Our main outcome variables were reported changes in susceptibility to smoking defined using previously validated questions by Pierce et al. [11, 13], and change in smoking status from never- to ever-smoker. Further details on the variables included are available in the paper reporting data from the 2011 and 2012 surveys [10]. In this study we investigated changes in children who provided data in all three surveys, and compared changes observed between 2011 and 2012, and between 2012 and 2013, to explore the effects of implementation of the PoS display ban in large

				shops.
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8	
		(*b*) Describe any methods used to examine subgroups and interactions	N/A	
		(*c*) Explain how missing data were addressed		
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy		
		(*e*) Describe any sensitivity analyses	N/A	
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9	From the seven schools participating in the 2011, 2012 and 2013 surveys we received completed questionnaires from 4019, 3989 and 4014 participants, respectively. After excluding children who did not participate in all three years, and those with missing information on outcome variables, a cohort of 1035 children remained for analysis.
		(b) Give reasons for non-participation at each stage		N/A
		(c) Consider use of a flow diagram		N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-11	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	10/11	Table 1
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A	

Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	*10/11*	*Table 1*
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		
		Cross-sectional study—Report numbers of outcome events or summary measures		
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-14	Table 2 &3
		(*b*) Report category boundaries when continuous variables were categorized		
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	18 To our knowledge this is the first individually linked cohort study to explore changes in susceptibility to smoking, and smoking status, in relation to the removal of tobacco PoS displays from supermarkets and other large retailers in the UK; and hence the first to evaluate the associations between exposure and changes in susceptibility and smoking status before and after the introduction of the ban on PoS displays in supermarkets and other large shops. Our findings suggest that there was a reduction in the proportion of children noticing tobacco PoS displays after the ban was implemented. However, whilst our findings at univariable level suggest that children who noticed PoS displays more often were more likely to become susceptible to smoking and to become smokers, we did not find a statistically significant independent effect once

				potential confounders were taken into account. In this respect there was no difference in the results we obtained before and after the ban, when associations between main exposures and outcomes were consistently non-significant.
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18-19	These two pages fully cover limitations of the study
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-20	Cross-sectional and linked data from earlier waves of this cohort study clearly indicated that exposure to and awareness of tobacco PoS displays was associated with increased risk of becoming susceptible to smoking and also becoming a smoker [9, 10]. Previous studies elsewhere have also consistently suggest that being exposed to tobacco PoS promotion leads to increased likelihood of becoming susceptible to smoking, experimenting with smoking or becoming regular or occasional smoker [16, 17]. Although this tobacco policy is primarily aimed at reducing smoking uptake among

	children, it appears to have an effect on adult smoking by reducing the number of impulse purchases in jurisdictions where PoS bans are implemented [18]. Evaluation of the Irish tobacco PoS display ban suggested that removal of PoS displays had a potential to de-normalize smoking and young people felt that it could make it easier for them to abstain from smoking uptake [15]. Similarly, in Norway a PoS display ban implemented in 2010 was perceived as a barrier limiting access to tobacco products affecting brand attachment and therefore leading to de-normalization of smoking [19]. Evidence from previous research suggest that the 2012 partial PoS display ban had no immediate effect on smoking prevalence and cigarette consumption among adults, though a steeper reduction in prevalence was observed over the three years following the ban [17].

				However, a recent study exploring the effects of PoS display bans in New Zealand suggests that implementation of the ban led to a reduction in initiation, experimentation and regular smoking among young people [20]
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-19	
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22	This study is funded by the Department of Health, Cancer Research UK and the UK Centre for Tobacco and Alcohol Studies (http://www.ukctas.net). Funding from the British Heart Foundation, Cancer Research UK, the Economic and Social Research Council, the Medical Research Council and the National Institute of Health Research, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged.

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.