Impact of removing point-of-sale tobacco displays: data from a New Zealand youth survey

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ABSTRACT

Introduction The tobacco industry increasingly invests in point-of-sale (POS) marketing. In July 2012, New Zealand required the removal of POS tobacco displays concurrently with increased enforcement and penalties for selling tobacco to minors, and additional restrictions on tobacco sponsorship. We evaluated the impact of these measures using a before–after study.

Methods We analysed data from annual surveys of more than 25 000 year 10 (14–15 years) students from 2007 and 2011 to 2014. Measures included prevalence of smoking-related behaviours and strength of association between visiting tobacco-retailing stores and smoking behaviours.

Results Between 2011 and 2014, smoking experimentation (had smoked ever but smoked less than monthly currently) decreased from 23% in 2011 to 17% in 2014 (adjusted odds ratio (aOR) 0.73, 95% CI 0.69 to 0.78); current smoking (at least monthly) prevalence from 9% to 7% (aOR 0.71, 0.64 to 0.79) and initiation in the last year from 13% to 11% (aOR 0.91, 0.84 to 0.98). Attempted purchase of cigarettes in the past 30 days among smokers decreased from 30% in 2012 to 26% in 2013 (aOR 0.77, 0.63 to 0.91). Positive associations between frequency of visiting tobacco-retailing stores and smoking-related behaviours weakened post-implementation.

Conclusions The introduction of a POS display ban and concurrent measures was followed by significant reductions in initiation, experimental and regular smoking, attempted purchase of cigarettes, and reduced association between visiting tobacco-retailing stores and smoking behaviours. The findings suggest that POS display bans are important components of strategies to reduce smoking initiation among youth and young people.

INTRODUCTION

In response to increasing restrictions on tobacco marketing, the tobacco industry has invested more in point-of-sale (POS) marketing.[1 2] Systematic reviews of epidemiological and experimental studies conclude that POS displays are associated with increased susceptibility, experimentation and regular smoking among children.[3–5] Article 13 of the WHO Framework Convention on Tobacco Control recommends banning POS displays.[6] Several jurisdictions, including Canada, Iceland, Thailand, Ireland, Australia, UK, Norway and New Zealand (NZ), have now introduced restrictions or bans on advertising and displays of tobacco products in retail settings.

Bans on retail displays have been hypothesised as reducing smoking susceptibility, experimentation and prevalence among youth through mechanisms such as reduced perceived prevalence of smoking among peers; decreased visibility, perceived availability and ease of purchase of tobacco products; and reduced tobacco sales to minors.[7] Impacts on adult smoking have been hypothesised as occurring through mechanisms like reduced impulse purchasing and stimuli to smoke among smokers or decreased triggers to resume smoking among quitters.[7]

Despite increasing adoption of POS display bans, few evaluation studies have been reported. Norwegian, Irish, NZ and Australian studies variously found strong public support after implementation of POS display bans[8–11] and high retailer compliance.[9 10] An International Tobacco Control Project cohort study investigated POS display bans in Canada and Australia.[12] Canadian and Australian smokers reported reductions in noticing POS displays and exposure to POS tobacco advertising, and made fewer impulse purchases of cigarettes than smokers in the USA and UK, where POS bans had not been introduced.[12] In Norway, reduced proportions of smokers and occasional smokers reported being tempted to buy tobacco products at the POS.[9] In Ireland, there were no significant short-term (up to 1 year post-POS ban) changes in smoking prevalence or retail sales over and above seasonal and long-term trends.[7] However, 14% of adult smokers thought the POS ban had made it easier to quit smoking.[7]

For youth and young adults, before–after studies from Australia found reduced smoking prevalence, recall of POS tobacco displays, tobacco brand awareness and overestimation of peer smoking among 12–25 years old after a POS display ban.[8] In Ireland, among 13–15 years old, recall of displays and the proportion overestimating smoking prevalence among children their age decreased, and many (38%) thought the ban would make it easier for children not to smoke. However, there were no significant short-term changes in smoking prevalence.[7]

To reduce the social acceptability of smoking among young people, the 2003 NZ Smoke-free Environments Amendment Act introduced a series of POS regulations for tobacco retailers including limiting the number of packages that could be displayed and their proximity to children's products.[13 14] However, subsequent research found that these regulations were poorly enforced.[15] Furthermore, a subsequent study found that Year 10 students who most commonly visited stores with POS displays had increased smoking susceptibility, experimentation and regular smoking prevalence. This suggested that the 2003 POS regulations did not protect youth from exposure to tobacco products.[16]

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In 2011, the Smoke-free Environments (Controls and Enforcement) Amendment Act was introduced; this statute required complete removal of POS tobacco displays by July 2012.[17] In addition, the Act banned the 'covert' tobacco sponsorship of events such as fashion and music shows, and the display of images of tobacco packs or brands on internet sale sites. The Act also tightened enforcement provisions for retail sales to minors by giving Smokefree Enforcement Officers powers to issue instant infringement fines to those found selling tobacco products to people aged under 18 years. Maximum penalties for selling tobacco products to minors increased from $2000 to $5000 for an individual and $10 000 for a business. Since the POS ban was introduced, the only monitoring that has taken place has been public opinion surveys.[11] No formal impact evaluation has been conducted.

We report on a study that evaluated the impact on year 10 students of the 2012 NZ POS tobacco product display ban and concurrent measures to restrict tobacco promotion and enhance enforcement of retail sales restrictions to minors.

METHODS

Survey method and sample

Our data were sourced from 5 years (2007, 2011–2014) of an annual survey of year 10 (14–15 years old) school students undertaken by Action on Smoking and Health (ASH) NZ and funded by the NZ Ministry of Health.[18] All public and private schools teaching year 10 students were invited to take part. Data were collected in August and September (late Winter) in 2007, and in June and July (mid-Winter) in the 2011–2014 surveys. Data collection in 2012 ended before the POS display ban was introduced on July 23. Participating schools administered the survey to all year 10 students during class time, under the supervision of teaching staff. Individual students could choose not to participate. To maintain confidentiality, students did not provide identifying information and teachers were asked not to check returned questionnaires.[18] Ethical approval was granted by the Ministry of Health Multiregional Ethics Committee in 2007.

The surveys contained questions that allowed us to examine associations between smoking-related behaviours and exposure to POS displays (2007 and 2013), and to describe smoking-related attitudes and behaviours (2011–2014) before and after the POS display ban. Table 1 summarises the questions asked by year of survey.

Outcome measures: susceptibility and smoking status

We assessed smoking status using two questions: 'Have you ever smoked (even a few puffs)?' (with yes or no response) and 'How often do you smoke now?'. The latter question had the response options 'I have never smoked/I am not a smoker now', 'less often than once a month', 'at least once a month', 'at least once a week' and 'at least once a day'. We defined respondents who reported smoking at least monthly as current smokers. We defined experimental smokers as respondents who had ever smoked but smoked less than monthly at the time of the survey.

We classified never-smokers as susceptible or non-susceptible using two questions derived from the Global Youth Tobacco Survey and originally adapted from Pierce *et al*'s[19] three-question measure. Non-susceptible respondents answered 'definitely no' to both the following questions: 'If one of your best friends offered you a cigarette, would you smoke it?' and 'At any time during the next year, do you think you will smoke a cigarette?'. We defined all other never-smokers as susceptible smokers.

We used the question: 'Did you try a cigarette/tobacco for the first time in the past year (12 months)?' to assess smoking initiation in the last year.

Table 1 Principal study measures and years of data collection

Data item	Years data collected
Smoking status and susceptibility	2011–2014
Smoking initiation (started in last year)	2012–2014
Perceived peer prevalence of smoking	2012–2014
Usual source of cigarettes	2012–2014
Attempted purchase from shop in past 30 days	2011–2013
Tobacco-retailing store visit frequency	2007, 2013

Key measures: store visit frequency, perceived peer prevalence and source of supply

We used a measure of store visit frequency, available only in the surveys from 2007 to 2013, to assess exposure to tobacco displays in retail settings. Students recorded how often they visited three store types representing the main tobacco retail settings in NZ: dairies (local term for a small general store) and convenience stores, petrol/service stations and supermarkets. The response options ranged from 'more than once a day' to 'less than once a week' and 'never'. Following a previous analysis using the 2007 data,[16] we derived a variable, 'store visit frequency', based on each respondent's most frequently visited store type. This variable divided students into the categories: 'at least daily *(daily+)*', '2–3 times/week', 'weekly' and 'less than weekly (<weekly)'.

We assessed perceived peer prevalence of current smoking using a question first asked in 2012: 'Out of 100 people your age, how many do you think smoke cigarettes at least once a month?'. We used this measure because overestimation of peer smoking prevalence is a risk factor for smoking uptake among youth,[20 21] and POS display bans may reduce perceptions of smoking as a common and 'normal' social behaviour.[8]

We assessed usual source of cigarettes among smokers in the 2011–2014 surveys through the question 'During the past 30 days (one month), how did you usually get your own cigarettes?' The response options were: (1) 'I bought them from a shop'; (2) 'I bought them from a vending machine'; (3) 'I bought them from a friend/friends or person my age'; (4) 'a friend/friends or person my age gave them to me'; (5) 'a parent or caregiver gave them to me'; (6) 'I took them from a parent or caregiver without asking'; (7) 'I got them from an older brother or sister' and (8) 'I got them some other way'. For analysis, as in previous studies,[22 23] we combined categories 1 and 2 (commercial source), 3 and 4 (friend source), 5 and 6 (parental source), and 7 and 8 (other source). We focused on the commercial source of supply, since the POS display ban potentially most directly affected this supply route.

Finally, between 2011 and 2013, we assessed the frequency of attempted purchase of cigarettes from a shop using the question: 'Have you tried to buy cigarettes or tobacco in a shop in the past 30 days (1 month)?'.

Covariates

The ASH questionnaire includes questions on variables associated with smoking status, including age, gender, ethnicity, friend and parental smoking status, and whether people smoked inside the respondent's home (yes, no or sometimes). Friend

and parental smoking status was collected via the question 'Which of the following people smoke?'. It had response options: (1) *mother*; (2) *father*; (3) *other caregivers (eg, step-father or mother, foster parents)*; (4) *older brother or sister*; (5) *best friend*; (6) *other close friends* and (7) n*one of these*. We derived friend smoking status (any friends: smoker or not) using responses to options 5 and 6, and parental smoking status (neither, one or both) using responses to options 1–3.

Respondents could choose more than one ethnicity, so the ethnic classification used here is based on a priority ordering of Māori (the indigenous people of NZ), Pacific, Asian, NZ European and other for multiple specifications. This is consistent with the method used in other NZ surveys including the NZ Tobacco Use Survey.[24]

Finally, we used the decile rating (an socioeconomic status (SES) measure) allocated to the school of the responding student as a measure of the SES. We grouped deciles into three categories: *low* (1–3), *medium* (4–7) and *high* (8–10). These have been used previously in research on this data set,[25] and provide for more stable weights against a variable that is an inherently imprecise, though still useful, gauge of SES.

Statistical analysis

For prevalence of smoking, initiation of smoking, susceptibility to smoking, perceptions of peer smoking prevalence, sources of supply and recent cigarette purchase from shops, we used binary logistic regression models to compare data from the latest year available after implementation (ie, 2014, or if not available 2013) with data before implementation (ie, 2011 or 2012). We used 2011 data where it was available and the 2011 and 2012 figures were similar. Where no data were collected in 2011, or if there was a substantial change in a measure between 2011 and 2012 (suggesting a pre-existing secular trend), we used the 2012 data. Data collection in 2012 was completed before implementation of the POS display ban.

The logistic regression models included adjustment for relevant covariates (demographic variables in all models; smoking status for estimates of peer smoking prevalence; and friend, parental smoking, and smoking in the home for smoking status, initiation and susceptibility). We performed analysis using Stata V.12.0 (StataCorp LP, 2012), and used the Stata LOGISITC command to generate logistic regression models.

Second, we used binary logistic regression models to investigate associations between store visit frequency and three different outcomes: smoking susceptibility, experimentation or current smoking in 2007 and 2013. We report adjusted ORs (aORs) controlled for age, sex, ethnicity, school-level SES, friend and parental smoking status and whether smoking occurred in the home or not.

The Stata version 12.0 *svy* procedure was used to estimate model parameters. This procedure enables adjustment for complex survey designs including clustering and weighting. To mitigate potential bias due to differential under-response, we weighted the data in each year by ethnicity and school SES for all analyses. We also standardised the age distribution to that seen in 2007 (ie, 65% 14 years old and 35% 15 years old) to account for differences in survey field timing. Confidence intervals were adjusted for clustering at the school level. We used two-sided significance tests, with $p<0.05$.

RESULTS

Survey numbers and response rates

More than 25 000 students responded to the survey in each of the years analysed (see online supplementary table S1). School-level participation rates varied between 47% and 56% and pupil participation rates ranged between 42% and 52%. The demographic characteristics of the returned sample have remained broadly stable over time (see online supplementary table S2), with the exception being the age profile for the 2011–2014 surveys, which were fielded earlier in the school year than previous ASH year 10 surveys, when fewer students had turned 15 years. A comparison of sample characteristics with those of the year 10 population available from the NZ Ministry of Education showed modest systematic over-response by NZ Europeans and under-response by those in the lower SES groups (see online supplementary table S3) in most years, with no major change before and after the POS display ban implementation.

Changes in smoking susceptibility, prevalence and initiation; peer smoking prevalence estimates; and source of supply over time

Smoking status prevalences were similar in 2011 and 2012. Between 2011 and 2014, the odds of current smoking and experimentation with smoking fell, while the odds of never smoking increased after adjusting for a range of potential confounding factors (table 2). Among non-smokers, susceptibility to smoking increased between 2011 and 2014, but this change was

Table 2 Smoking status and initiation 2011–2014

	2011 N		2012 N		2013 N		2014 N		
Sample N (weighted)	**26 645**	**Per cent**	**28 451**	**Per cent**	**27 926**	**Per cent**	**31 021**	**Per cent**	**Before–after comparison aORs***
Smoking and susceptibility status									**2014 vs 2011**
Never-smoker, not susceptible	13 688	51	14 616	51	15 050	54	17 193	55	**1.15 (1.09–1.22)**
Never-smoker, susceptible	4275	16	4602	16	5185	19	5983	19	**1.26 (1.18–1.33)**
Experimented	6054	23	6781	24	5387	19	5274	17	**0.73 (0.69–0.78)**
Currently smoke (monthly+)	2521	9	2452	9	2139	8	2110	7	**0.71 (0.64–0.79)**
Non-response	101	1	0	0	149	1	461	2	
Tried cigarette first time (past 12 months)									**2014 vs 2012**
Yes			3628	13	3245	12	3394	11	**0.91 (0.84–0.98)**
No			24 563	86	24 544	88	27 348	89	**1.1 (1.02—1.19)**
Non-response			259	1	136	0	279	0	

ORs are bolded where 95% CIs do not overlap the null.
*aORs controlled for age, sex, ethnicity, SES, friend and parent smoking status, smoking in home.
aOR, adjusted OR; SES, socioeconomic status.

Table 3 Perceived peer prevalence of current smoking 2012–2014

	2012		2013		2014		2014 vs 2012	
	N	Per cent	N	Per cent	N	Per cent	aOR*	95% CI
0–19%	4941	17	5555	20	6642	21	**1.3**	**(1.21 to 1.4)**
20–39%	6842	24	6773	24	7557	24	1.01	(0.94 to 1.09)
40–59%	7076	25	6920	25	7399	24	0.98	(0.93 to 1.03)
60–79%	4626	16	3909	14	4083	13	**0.8**	**(0.75 to 0.86)**
80–100%	3544	12	2758	10	3424	11	0.93	(0.84 to 1.02)
Non-response	1422	5	2010	7	1917	6	—	—

ORs are bolded where 95% CIs do not overlap the null.
*aORs controlled for age, sex, ethnicity, SES, smoking status, friend and parent smoking status, smoking in home.
aOR, adjusted OR; SES, socioeconomic status.

more than offset by reductions in current and experimental smoking. The adjusted odds of trying a cigarette for the first time in the previous 12 months also reduced between 2012 and 2014.

Table 3 shows the estimates of perceived peer prevalence of current (at least monthly) smoking from 2012 to 2014. Overestimation of prevalence was extremely common and the proportion estimating prevalence at <20% (encompassing the true figure of 6–8% during these years) was low throughout, though increased slightly between 2012 and 2014.

The mean estimate of peer smoking prevalence among all participants decreased from 44% in 2012 to 41% (95% CI for difference 1.5% to 4.5%) in 2014 (table 4), with the greatest reduction among current smokers.

Table 5 shows changes in source of supply before and after implementation among current smokers. Although not statistically significant, the proportion of current smokers whose usual source of supply was to buy from a shop decreased between 2012 and 2014. The proportion reporting attempts to buy tobacco from a shop in the past 30 days decreased between 2012 and 2013 (aOR 0.77, 95% CI 0.63 to 0.91).

Association between store visit frequency and smoking status

Reported store visit frequency at respondents' most frequently visited tobacco-selling store type decreased between 2007 and 2013 (see online supplementary table S4). For example, the proportion that reported visiting any tobacco-retailing store type at least daily was 19% in 2007 compared with 12% in 2013.

Table 6 shows the associations between smoking status (current, experimental smoker and susceptible non-smoker) and store visit frequency at the most frequently visited store type in 2007 and 2013. Strength of association between higher store visit frequency and both susceptibility and experimentation with smoking decreased in 2013 relative to 2007 except for the association between at least daily visits and susceptibility. Decreases in association with store visit frequency were greater for experimentation compared with susceptibility to smoking (though no formal statistical tests were conducted to compare change in aORs between categories). Associations between reported store visit frequency and current smoking were largely unchanged.

DISCUSSION

This study investigated changes in susceptibility to smoking, smoking prevalence, smoking initiation and frequency of attempted purchase of tobacco from retail outlets among year 10 students following the implementation of a POS display ban. We detected a reduction in each outcome measure, consistent with the POS display ban and concurrently implemented measures reducing smoking-related behaviours. Positive associations between frequency of visiting tobacco-retailing stores[16] and experimentation with smoking and smoking susceptibility reported in earlier studies were weakened. The findings were consistent with the previous literature reporting mainly positive effects of POS display bans from Ireland, Norway and Australia.[6–8]

There was a small reduction in perceived peer prevalence of current smoking, though a substantial overestimate remained, possibly due to other normalising influences on smoking such as widespread smoking in movies,[26 27] widespread exposure to other tobacco product promotion[28] and exaggerated perceptions of peer group and community practices.[29 30]

Our study has several strengths. The data come from large, nationally representative surveys that use a consistent methodology and where most questions were stable over time. We also report on a comprehensive range of outcome measures, including changes to smoking susceptibility.

However, our study also has some caveats. Firstl, this is a before–after uncontrolled study, so some changes observed after

Table 4 Mean perceived peer prevalence of current smoking in 2012 and 2014

Smoking status	2012 N	Mean (%)	2014 N	Mean (%)	Difference in per cent between years (95% CI)		p Value
Overall	27 029	43.7	29 173	40.6	**3.0**	**(1.5 to 4.5)**	**<0.001**
Never-smoker, not susceptible	13 783	36.6	16 611	35.2	**1.4**	**(0.3 to 2.7)**	**0.016**
Never-smoker, susceptible	4391	40.2	5784	39.5	0.7	(−0.8 to 2.1)	0.329
Experimented	6513	53.5	4834	51.0	**2.5**	**(0.9 to 4.1)**	**0.005**
Currently smoke (monthly+)	2342	64.0	1710	59.9	**4.2**	**(2.0 to 6.3)**	**<0.001**

ORs are bolded where 95% CIs do not overlap the null.
All estimates are weighted by school-based socioeconomic indicator, ethnicity and age. CIs are adjusted for clustering at the school level. Missing cases for either question are excluded.

Table 5 Usual source of supply and trying to buy from a shop in past 30 days (current smokers only)

	2011		2012		2013		2014		Before–after comparison aOR* (95% CI)	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent		
Usual source of cigarettes in past 30 days										2014 vs 2012
Bought from shop	458	18	355	14	244	11	226	11	**0.74**	**(0.57 to 0.97)**
From friends/peers	796	32	796	32	777	36	734	35	**1.09**	**(1.01 to 1.21)**
From parents/caregivers	319	13	320	13	283	13	257	12	0.98	(0.77 to 1.24)
Other	566	22	567	22	525	25	489	23	0.99	(0.82 to 1.21)
Non-response	382	15	483	19	312	15	404	19		
Tried to buy from shop in past 30 days										2013 vs 2012
Yes	908	36	728	30	566	26			**0.77**	**(0.63 to 0.91)**
No	1546	61	1595	65	1508	71			**1.32**	**(1.1 to 1.58)**
Non-response	66	3	129	5	64	3				

ORs are bolded where 95% CIs do not overlap the null.
*aORs controlled for age, sex, ethnicity, SES, friend and parent smoking status, smoking in home.
aOR, adjusted OR; SES, socioeconomic status.

implementation of the POS ban may represent the continuation of pre-existing trends. This explanation is most plausible for the reduction in smokers attempting to buy from a shop, as there were large reductions before implementation between 2011 and 2012. Pre-existing trends are an unlikely explanation for changes in current and experimental smoking, and smoking susceptibility after implementation, as these prevalences were stable from 2011 to 2012, but decreased subsequently. However, even if the changes wholly or partially continue pre-existing trends, the continuation of these trends may not be inevitable and may depend on new tobacco control measures. If so, the POS display ban could have supported and maintained ongoing positive trends.

Table 6 Associations between tobacco-retailing store visit frequency and smoking status (susceptible, experimented or current monthly+smoker)

	2007 aOR*	95% CI	2013 aOR*	95% CI
Outcome: susceptible				
Store visit: <weekly	1.00	(Reference)	1.00	(Reference)
Store visit: weekly	**1.42**	**(1.24 to 1.63)**	**1.13**	**(1.01 to 1.28)**
Store visit: 2–3 times/ week	**1.89**	**(1.67 to 2.13)**	**1.61**	**(1.44 to 1.81)**
Store visit: daily+	**1.83**	**(1.56 to 2.14)**	**1.94**	**(1.64 to 2.30)**
Outcome: experimented				
Store visit: <weekly	1.00	(Reference)	1.00	(Reference)
Store visit: weekly	**1.37**	**(1.21 to 1.54)**	**0.73**	**(0.63 to 0.83)**
Store visit: 2–3 times/ week	**1.98**	**(1.75 to 2.25)**	1.08	(0.97 to 1.19)
Store visit: daily+	**2.66**	**(2.22 to 3.18)**	**1.68**	**(1.50 to 1.89)**
Outcome: current smoker (monthly+)				
Store visit: <weekly	1.00	(Reference)	1.00	(Reference)
Store visit: weekly	1.12	(0.92 to 1.36)	0.9	(0.71 to 1.14)
Store visit: 2–3 times/ week	1.14	(0.95 to 1.37)	1.06	(0.87 to 1.28)
Store visit: daily+	**1.95**	**(1.63 to 2.32)**	**2.01**	**(1.62 to 2.5)**

ORs are bolded where 95% CIs do not overlap the null.
*aORs controlled for age, sex, ethnicity, SES, friend and parent smoking status, smoking in home.
aOR, adjusted OR; SES, socioeconomic status.

Second, confounding factors such as other tobacco control measures implemented between the baseline and follow-up surveys may have been responsible for some or all of the changes in the outcomes observed. The major relevant tobacco control policy measures implemented between 2011 and 2014 were above inflation increases in tobacco excise tax, introduction of smoke-free outdoor policies (eg, in parks, sports fields and playgrounds)[31] and the launch of a new mass media campaign in June 2014. Other tobacco control interventions in NZ occurred after the study period (eg, restrictions to duty-free sales) or would have had limited impact on this age group (eg, smoke-free prisons).

Tobacco excise tax increases of 10% above inflation occurred annually between 2010 and 2014, with an additional 14% increase for roll-your-own tobacco in 2010. These could plausibly have affected susceptibility, experimentation, initiation and current smoking prevalence and purchase of tobacco in shops, though this would not have biased the results unless the impact occurred differentially before and after implementation of the POS display ban.

Extensions of smoke-free policies occurred in some jurisdictions in NZ during the study period. These may have had a minor impact on smoking, smoking susceptibility and perceived peer prevalence of smoking, but any significant effect on purchase of tobacco from shops seems unlikely.

A new mass media campaign ('Stop before you start') aimed at reducing smoking uptake among young adults, but which may also have impacted younger youth, was launched during the 2014 data collection time period in June. It is unlikely to have significantly affected the smoking behaviours over such a short time period. Furthermore, overall mass media expenditure by the Health Sponsorship Council (the forerunner of the current national health promotion agency) declined between 2010/2011 and 2012/2013 (2014 data not available), and may have offset any impact of the new campaign.

None of these confounding interventions seem likely to have reduced the association between frequency of visiting tobacco retailers and smoking-related behaviours between 2007 and 2013, particularly as a ban on the display of tobacco product prices was introduced concurrent with the POS ban in 2012, minimising the visibility of the price increases among this age group. However, the 6-year gap between 2007 and 2013 means alternative explanations for the reduced aORs observed for

associations of smoking-related behaviours with frequency of visiting tobacco-retailing stores are possible. For example, the sensitivity of year 10 students to smoking cues in the environment may have reduced during this period, as the overall smoking prevalence reduced in NZ.

Furthermore, due to the cross-sectional nature of the data, part of the associations of store visiting frequency (and hence exposure to POS displays) with smoking-related behaviours may represent 'reverse causation'. This could occur if regular smokers, or those who have experimented with smoking, subsequently becoming more likely to visit tobacco retailers, for example, in order to purchase cigarettes. The finding that following the POS display ban, the association was eliminated or weakened for experimental smokers and susceptible non-smokers, but not for current smokers, supports this explanation. This is because reverse causation is most plausible (and hence the association more likely to persist after the POS ban) for current smokers who are likely to visit stores selling tobacco more often in order to buy cigarettes. This finding also suggests POS display bans will have the greatest effect on reducing smoking susceptibility and experimentation, and less impact on established youth smokers.

Finally, the 2011 Act included concurrent interventions to limit covert sponsorship, and also increased enforcement and penalties for selling tobacco to minors. These parallel measures are likely to have had only a minor impact on smoking susceptibility and uptake as few 14–15 years old attend fashion shows and music festivals events, and a minority of 14–15 years old smokers obtain their cigarettes from shops (table 5). Enhanced enforcement measures could have affected purchase of tobacco from shops, so changes in attempted purchase and usual source of cigarettes from shops are best interpreted as resulting from the combined interventions included in the Act.

Given these limitations, further research (eg, using time series and multilevel analyses) could explore whether changes introduced in the 2011 Act had impacts over and above longer term trends in smoking-related behaviours, and whether such impacts were present after adjusting for the effect of potential confounding interventions, such as tobacco taxation, mass media and extension of smoke-free environments. In addition, more in-depth studies could extend understanding of factors promoting the marked overestimation of peer prevalence of smoking, and explore measures that could ameliorate misperceptions. Finally, our study, like others from Norway, Australia and Ireland,[6–8] has a relatively short follow-up period. Additional studies over a longer time period postintervention could provide important insights into how policy effects evolve over time.

Owing to these limitations the results are not definitive. Our findings are consistent with the NZ POS display ban resulting in decreased smoking, smoking susceptibility, experimentation and initiation among the 14–15 years old students and a modest reduction in adolescents' tendency to overestimate smoking among their peers. However, some of the changes may be attributable to confounding, particularly concurrent increases in tobacco excise. The findings are also consistent with the combined interventions (POS display ban and enhanced enforcement of retail sales to minors) resulting in reduced attempted purchase of cigarettes from shops by youth smokers.

Overestimation of peer smoking prevalence remains substantial and its association with smoking initiation and experimentation is concerning.[32] Further efforts are therefore required to protect youth from smoking and reduce perceptions of smoking as a normal social practice. Measures expanding smoke-free public places and making movies and TV programmes smoke free could help address this problematic finding.

The findings support the WHO Framework Convention on Tobacco Control recommendations[5] and reinforce the international literature that POS display bans are an important component of a multifaceted strategy to reduce smoking initiation among youth and young people. Moreover, our comprehensive analyses contradict tobacco industry claims,[33] and so should reassure policymakers yet to implement POS display bans.

What this paper adds

Point-of-sale display bans are being introduced in an increasing number of jurisdictions. Evaluation of the impact of display bans has been limited. This study presents a multifaceted evaluation of the impact of display bans on youth. We found evidence of positive impacts with reductions in smoking-related behaviours, attempted purchase of tobacco from shops and overestimation of peer prevalence of smoking. We also found a weakening of previously documented associations between the frequency of visiting stores selling tobacco products and susceptibility to and experimentation with smoking.

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Contributors RE conceived the idea for the paper, organised obtaining the data, planned the analysis (with AA and BH) and wrote the first and subsequent drafts. AA carried out the final analyses included in the paper and commented on drafts and approved the final version. BH was involved in discussions developing ideas for the paper, carried out initial analyses for the paper, and commented on drafts and approved the final version. JH was involved in discussions developing ideas for the paper, and commented on drafts and approved the final version.

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