Addiction

RESEARCH REPORT

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Do graphic health warning labels have an impact on adolescents' smoking-related beliefs and behaviours?

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ABSTRACT

Aims To assess the impact of the introduction of graphic health warning labels on cigarette packets on adolescents at different smoking uptake stages. **Design** School-based surveys conducted in the year prior to (2005) and approximately 6 months after (2006) the introduction of the graphic health warnings. The 2006 survey was conducted after a TV advertising campaign promoting two new health warnings. **Setting** Secondary schools in greater metropolitan Melbourne, Australia. **Participants** Students in year levels 8–12: 2432 students in 2005, and 2050 in 2006, participated. **Measures** Smoking uptake stage, intention to smoke, reported exposure to cigarette packs, knowledge of health effects of smoking, cognitive processing of warning labels and perceptions of cigarette pack image. **Findings** At baseline, 72% of students had seen cigarette packs in the previous 6 months, while at follow-up 77% had seen packs and 88% of these had seen the new warning labels. Cognitive processing of warning labels increased, with students more frequently reading, attending to, thinking and talking about warning labels at follow-up. Experimental and established smokers thought about quitting and forgoing cigarettes more at follow-up. At follow-up intention to smoke was lower among those students who had talked about the warning labels and had forgone cigarettes. **Conclusions** Graphic warning labels on cigarette packs are noticed by the majority of adolescents, increase adolescents' cognitive processing of these messages and have the potential to lower smoking intentions. Our findings suggest that the introduction of graphic warning labels may help to reduce smoking among adolescents.

Keywords Adolescents, behaviour, beliefs, graphic health warnings, smoking.

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INTRODUCTION

Health-warning labels on cigarette packs provide a means of informing smokers about the health risks associated with smoking. However, not all warning labels are equally effective at this task. Warning labels that are large, contain a direct and specific message about the risk associated with smoking and depict the risk in a vivid colour photograph are more effective at increasing smokers' knowledge of health risks and motivating them to quit than small text-based labels [1–3]. The Framework Convention on Tobacco Control (FCTC) requires signatory countries to implement health warnings on cigarette packs that are, at a minimum, large, clear and cover at least 30% of the pack surface [4]. The FCTC also suggests that warning labels include pictures [4]. To date most research on the effects of graphic health warnings has been conducted with adults and has focused upon whether they promote quitting intentions and behaviour [2,5–8]. One group that may also be influenced by graphic health warning labels are adolescents. As adolescence is still the period when most smoking uptake occurs, graphic health warnings may be an effective means of reducing adolescents' propensity to smoke.

The published work examining the effect of any type of health warnings on adolescents' smoking-related attitudes, knowledge and behaviours is relatively small [9–14]. One longitudinal study of the impact of small text-based labels found that a sizable proportion of adolescent smokers did not see or remember them and awareness of the labels was not associated with reduced smoking [9]. Other work has suggested that adolescents do not believe graphic health warnings will influence adolescents who already smoke [10]. In contrast to these

results, an experimental study of 18–24-year-old smokers and ex-smokers showed that graphic warning labels were more effective than text-based warnings at motivating smokers to quit and ex-smokers to remain quit [11]. Research is needed to examine how adolescents respond to graphic health warnings when they are introduced in practice.

From March 2006 all new cigarette packs produced in Australia had to contain one of seven new graphic health warnings. Like the Canadian warning labels, the new warnings consisted of a written warning and a vivid colour image on both the front (taking up 30%) and back of the cigarette pack, with 90% of the back containing information on the health effects of smoking. These new warnings replaced a set introduced in 1995 that were text-based and covered the top 25% of the front and top third of the back of a pack. To promote the new warning labels, two television commercials were created to depict two of the new health warnings ('smoking causes mouth and throat cancer' and 'smoking causes peripheral vascular disease') used on cigarette packs. While the target audience for these commercials was adult smokers, previous research has shown that adolescents have a high awareness of these types of campaigns and can be influenced by them [15,16].

The present study examines the impact of the introduction of graphic health warnings on cigarette packs on adolescents' knowledge of risks associated with smoking and their response to the health warnings. Research with adult smokers has examined whether graphic health warnings are associated with a greater level of cognitive processing and whether this is associated with increased quitting intentions [5,7]. Cognitive processing reflects the extent that information is attended to and elaborated upon, and is suggested to be an important determinant of attitude formation in response to new information [7]. In studies of adult smokers, reading, thinking about and discussing the warning labels are used as indicators of cognitive processing [5,7]. We adopt this approach and examine whether the introduction of graphic health warnings increased adolescents' cognitive processing of the warning labels and whether cognitive processing of these labels was associated with reduced smoking intentions.

Data for this paper are from a study designed originally to examine the impact of the introduction of graphic health warning labels before and after an advertising campaign promoting the new warning labels. Baseline data are from a survey of adolescents conducted in the year prior to the graphic health warning labels introduction (2005). In 2006, schools participating in the 2005 study were asked to take part in either the pre-advertising survey (conducted about 6–8 weeks after the new warning labels introduction date) or the post-advertising study (conducted about 6 months after the graphic warning labels introduction and after the advertising campaigns). However, in practice there was substantial delay in retail outlets receiving cigarette packs with the graphic warnings labels, with only around 50% of cigarette packs sold at the end of April 2006 carrying the new labels [17]. Due to this, we use data from the baseline survey and the post-advertising survey only to examine the impact of graphic health warning labels on knowledge and cognitive processing of warning labels.

METHOD

Study design

An outline of the study design, the number of schools participating in each survey and average number of students surveyed is shown in Fig. 1. In 2005, a national study on the prevalence of substance use among Australian adolescents was conducted. This study was designed to collect cross-sectional data from a random sample of Australian students in years 7–12 (aged 12–17 years). Schools located in the greater metropolitan area of Melbourne, the capital of the Australian state of Victoria, who participated in this survey formed the target group for the current study. In 2006 we invited these schools to participate in a second study and aimed to re-survey students who had participated in the 2005 study (2006 year levels 8–12). We intended to use details on students' date of birth, gender and postcode within each school to match students across surveys. Due to school restrictions, it was not possible to re-survey specific students in more than half of the participating schools. A relatively small number of students ($n = 680$) participated in both the baseline and the second follow-up survey, limiting the original cohort study design. Therefore we treated the data as being from two cross-sectional surveys.

2005 survey

Sample and method

Schools were selected randomly from the three main education sectors to ensure proportional representation. Principals of selected schools gave permission to conduct the survey. Schools refusing participation were replaced by a school geographically closest to them within the same education sector selected at the same time as the original sample. Using the school roll, researchers selected students randomly from predetermined year levels. In anticipation of some students being absent on the survey day, replacement students were also selected from each year level (see Fig. 1).

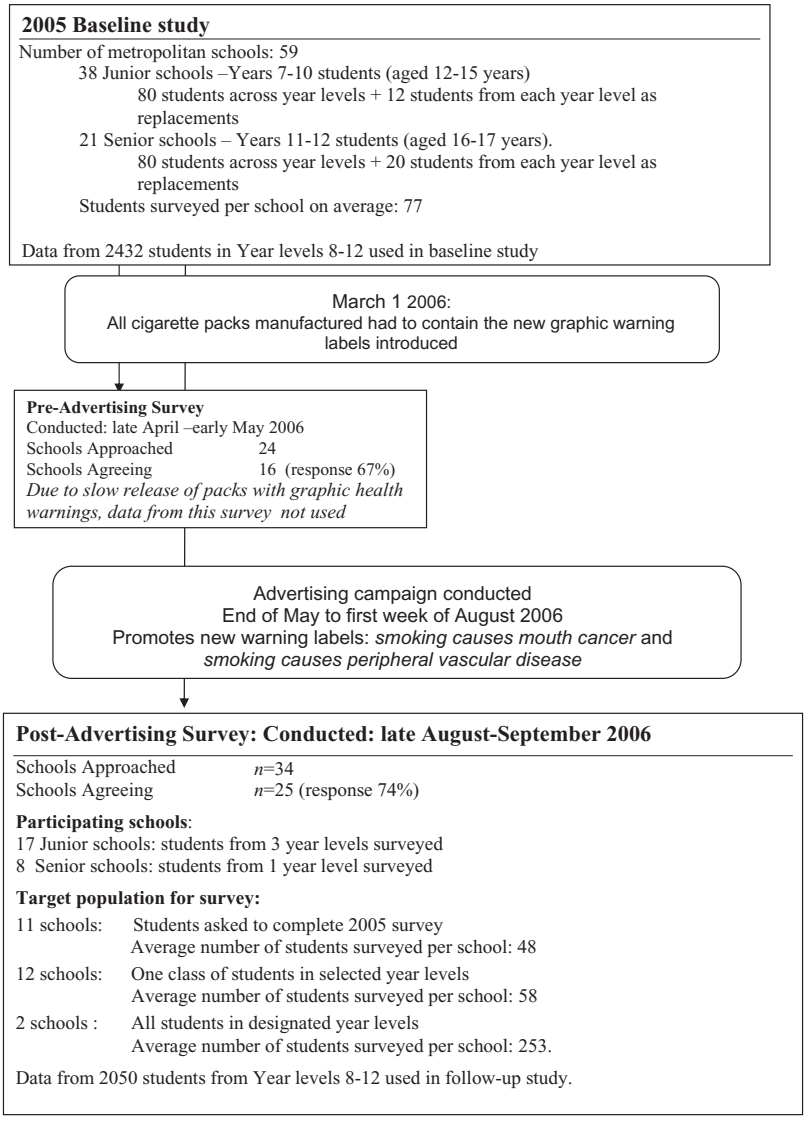

Figure 1 Number of schools participating in each of the three surveys and timing of surveys in relation to introduction of graphic health warnings and advertising campaign promoting warning labels

2006 survey

Sample

In 2006, we approached the 59 metropolitan schools regarding study participation. Twenty-four schools were assigned to the pre-advertising survey and 35 to the post-advertising survey (follow-up). A total of 41 schools agreed to participate (69% response rate), including 25 follow-up schools. The sample of students for surveying is shown in Fig. 1, along with the average number of students surveyed. For reference, the average class size in Victorian secondary schools in 2006 was 22 [18].

Procedure 2005 and 2006

In both survey years, parents of students to be surveyed were informed of the study by letter and asked to indicate if they did not want their child to participate. On an agreed day, members of the research team attended the school to administer the pencil-and-paper questionnaire to students. Students consented to participate at the time of the survey. Surveys were completed anonymously. Few parents refused permission for their child to be surveyed (<1%) and few students did not consent to study participation (<1%). The main reasons for students not participating in the study were being absent from school on the survey day, participation in another school event and not attending the survey session.

MEASURES

Items common to 2005 and 2006 surveys

Stage of smoking

Students indicated whether they had smoked even part of a cigarette, with responses ranging from 1 = 'no' to 5 = 'yes, I have smoked more than 100 cigarettes in my

life'. Intention to smoke was assessed with the item: 'do you think you will be smoking this time next year?', with responses ranging from 1 = 'certain not to be smoking' to 7 = 'certain to be smoking'. Responses to these questions were used to determine stage of smoking [19]. Non-susceptible non-smokers had never smoked a cigarette and were certain not to be smoking in the future. Susceptible non-smokers had never smoked a cigarette but did not indicate a strong intention to not smoke in the future. Experimental smokers had previously had at least a puff of a cigarette but less than 100 cigarettes in their life-time. Students who had smoked more than 100 cigarettes in their life-time were designated established smokers.

Perceptions of health consequences of smoking

Students were asked to indicate on a five-point scale whether they agreed or disagreed that smoking caused a number of different illnesses or harms. The items reflected most of the graphic health warnings appearing on cigarette packs in 2006 (see Table 2). The graphic warning labels were a mix of completely new messages and re-presentations of labels used between 1995 and 2005. The 2006 warning label messages assessed were: 'smoking causes mouth and throat cancer' (new), 'smoking causes peripheral vascular disease' (new), 'smoking causes emphysema' (new), 'smoking clogs your arteries' (old) and 'smoking—a leading cause of death' (old). Examples of the new warning labels can be seen at http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-pubhlth-strateg-drugs-tobacco-warning-packs-A.htm.

Awareness and processing of warning labels

Based on Hammond *et al.* [7], students seeing a cigarette packet in the previous 6 months were asked how frequently they had read, paid close attention to, thought about and talked about the warning labels. In addition, students were asked how frequently they had not had a cigarette and had had a cigarette because of the warning labels. Students who had smoked in the previous 12 months were also asked to indicate how frequently they 'thought about quitting smoking because of the warning labels'. Responses were made on a five-point scale ranging from 'never' to 'every time I see them'.

Attraction of cigarette packs

The negative image accompanying the health warning and the size of the warning label on the cigarette pack may help to decrease the appeal of cigarette packs [20]. An adjective checklist assessed adolescents' attitudes toward the pack image. Students drew on their memory of cigarette packs and indicated whether they 1 = 'strongly disagreed' to 5 = 'strongly agreed' with four positive (e.g. cool, good), and four negative (e.g. gross, ugly) descriptions of cigarette packs. Students who had seen cigarette packs but were not able to comment gave an 'undecided' (=3) response. Positive and negative subscale scores were created by taking the average of the appropriate items. Both scales demonstrated good internal reliability (positive pack image scale: alpha = 0.85; negative pack image scale: alpha = 0.79).

Demographics

Students reported their sex, current age, birth-date and the suburb where they lived and postcode. This information was used to try to match students within schools across the two surveys. Students also reported on the smoking status of parents and their five closest friends.

Items unique to 2006 survey

After students had answered all questions described above, students were given a description of cigarette packs with the new warning labels and asked to indicate ('yes' or 'no') if they had seen them. Students were also given descriptions of each advertisement promoting the new health warnings and indicated 'yes' or 'no' to having seen them.

Statistical analyses

Baseline data are taken from the 41 schools that agreed to take part in the 2006 survey. As age may influence awareness of health warning labels and smoking behaviours we restricted analyses to students in years 8–12 at both time-periods to reduce age differences between the two surveys. The statistical package STATA [21] was used for analysis to accommodate the complex sample design. Logistic regression analyses compared proportions across smoking stage and time-periods. Linear regression analyses examined mean scores on the cognitive processing variables across survey periods. In these analyses, each cognitive processing variable was regressed onto survey period and the control variables age, sex, school type and smoking stage. An interaction term between survey period and smoking stage was fitted to determine if the effect of survey period was consistent across smoking stage. Linear regression also examined the association between smoking intentions and cognitive processing variables and positive or negative attitude towards the pack after controlling for age, sex, experience with smoking, smoking in the past week and parents' and friends' smoking. All analyses adjusted for clustering of students within school and standard errors robust to potential non-independence of students obtained.

Table 1 Characteristics of the baseline and follow-up samples.

	Baseline	*Follow-up*	*P-values*
Number of students	2432	2050	
Sex			
Males	40%	49%	0.021
Age (mean)	15.55	15.29	0.326
Year level (%)			
Year 8	19%	29%	0.022
Year 9	18%	19%	
Year 10	16%	18%	
Year 11	27%	7%	
Year 12	20%	26%	
At least one parent smokes	35%	34%	0.701
Any smoking among friends	45%	39%	0.214
Smoking stage* (%)			
Never smoked, not susceptible	44%	50%	0.030
Never smoked, susceptible	10%	10%	
Experimenter	37%	34%	
Established	9%	7%	
Intention to smoke in 12 months† (mean)	1.92	1.78	0.015
Among students who smoked in previous week			
Average number of cigarettes/week	28.9	22.1	0.037
Seen cigarette packs			
In past 6 months	72%	77%	<0.001
More than 6 months	12%	11%	
Never	15%	12%	
Of those seeing cigarette packs in past 6 months			
Saw new health warnings	NA	88%	
Saw advertisements promoting:			
Mouth cancer warning	NA	65%	
Peripheral vascular disease warning	NA	65%	

*See text for definition. †Measures on seven-point scale with higher scores indicating stronger intention to smoke. NA: not available.

RESULTS

Table 1 shows the characteristics of students in the two surveys. More females (60%) than males (40%) participated in the baseline survey, although at follow-up proportions were similar. More students were classified as non-susceptible never smokers at follow-up (50%) than baseline (44%). After controlling for age, gender was not associated with smoking status at baseline or follow-up. At least 70% of students in both surveys had seen a cigarette pack in the previous 6 months, with a slightly greater proportion at follow-up. Seeing cigarette packs was more common among students with some involvement with smoking at baseline ($P < 0.001$) and follow-up ($P < 0.001$). However, at follow-up 64% of non-susceptible never smokers and 80% of susceptible never smokers had seen cigarette packs in the previous 6 months. While students were more likely to see packs if they had a parent who smoked (86% cf. 69%) ($P < 0.001$) or a friend who smoked (86% cf. 67%) ($P < 0.001$), in both surveys more than 50% of non-susceptible non-smokers who did not have any smoking in their social environment had seen a cigarette pack in the 6 months prior to the survey. At follow-up, 88% of the students seeing cigarette packs had seen the new health warnings. Smoking involvement was associated with seeing the new warning labels ($P < 0.02$), with 84% of non-susceptible never smokers who had seen cigarette packs in the previous 6 months having seen the new warning labels, compared with 97% of established smokers. At follow-up 65% of students had seen the advertisements promoting the new health warnings.

The proportion of students in the baseline and follow-up surveys who agreed with the different health-related statements is shown in Table 2. The percentage of students agreeing with the two messages targeted in television advertisements ('causes disease in toes and fingers' and 'causes mouth cancer') increased significantly between baseline and follow-up. At follow-up, students seeing the mouth cancer warning advertisement were more likely to agree with this health risk (95%) than those not seeing the advertisement (84%) ($P < 0.001$). Students who saw the peripheral vascular disease warning advertisement were more likely to agree that smoking causes diseases in toes and fingers (83%) than

Table 2 Percentage of students at different smoking stages agreeing* that smoking can cause different illnesses or is harmful at baseline and follow-up.

	Smoking stage						
Items reflecting graphic warning labels released in 2006	*Never smoked Not susceptible %*	*Never smoked Susceptible %*	*Experimental Smoker %*	*Established Smoker %*	*Total*	*P-value linear trend smoking status*	*P-value for survey period*
Smoking:							
Can cause diseases in toes and fingers (new warning)							
Baseline	39	34	38	32	38	0.369	
Follow-up	77	77	76	72	77	0.311	<0.001
Can cause mouth cancer (new warning)							
Baseline	67	66	76	79	72	0.001	
Follow-up	91	88	93	90	91	0.819	<0.001
Clogs arteries (old warning)							
Baseline	80	80	84	80	81	0.543	
Follow-up	82	85	81	84	82	0.521	0.249
Causes emphysema (new warning)							
Baseline	68	67	73	78	71	0.059	
Follow-up	70	65	77	82	72	0.012	0.136
Is a leading cause of death (old warning)							
Baseline	80	75	77	68	77	0.005	
Follow-up	71	67	68	64	69	0.119	<0.001

*'Strongly agree' and 'agree' responses grouped together.

those not seeing this advertisement (64%) ($P < 0.001$). However, students at follow-up who had not seen these advertisements were still more likely to agree with these health risks than students at baseline (mouth cancer: $P < 0.001$; fingers and toes: $P < 0.001$). The proportion of students agreeing with the message 'smoking causes emphysema' (a new health warning) did not change.

Cognitive processing of the warning labels increased significantly between baseline and follow-up, as did frequency of forgoing a cigarette among experimental and established smokers (Table 3). In both surveys, susceptible never smokers reported less engagement with the warning labels, with established smokers reading and talking about the warning labels more frequently than non-susceptible never smokers. There was no significant interaction between survey period and smoking stage for any item. Students who had smoked in the previous 12 months thought about quitting more frequently at follow-up than baseline.

The positive image associated with the pack decreased and the negative image increased after the introduction of the graphic health warning labels (Table 3). While these changes were seen across all smoking stages, established smokers still had the most favourable image of cigarette packs at follow-up.

We repeated the above set of analyses excluding students who completed both surveys and found no difference in the pattern of results reported above.

We examined the association between smoking intention and degree of processing associated with warning labels among those who had seen the new warning labels at follow-up (Table 4). After controlling for the individual's smoking behaviour and the smoking of their parents and friends, talking about the warning labels more frequently, not having a cigarette in response to the warning labels and stronger negative perceptions of the pack were associated with lower intentions to smoke. Increased frequency of having a cigarette in response to the warning labels was associated with stronger smoking intention.

DISCUSSION

This study is one of the first to examine the impact of the introduction of graphic health warnings on cigarette packs on the smoking-related behaviours, perceptions and intentions of adolescents. As more than two-thirds of students surveyed had seen cigarette packs in the preceding 6 months, the study indicates that health-warning labels can reach adolescents. We found that the introduction of the graphic health warning labels led to an increase in the frequency of students attending to, and thinking and talking about them. Importantly, this increase was found among both experimental and established smokers, suggesting that graphic health warnings influence students currently in the process of taking up smoking as well as established smokers. In addition, the

Table 3 For students who had seen a cigarette pack in past 6 months, depth of cognitive processing of warning labels* and positive and negative image of cigarette pack for students at different smoking stages at baseline and follow-up.

	Smoking stage					*P-value*
	Never smoked Not susceptible	*Never smoked Susceptible*	*Experimental Smoker*	*Established Smoker*	*Total*	*for difference between surveys*
Read warnings						
Baseline	2.67	2.59	2.79	3.21	2.78	
Follow-up	2.74	2.52	3.02	3.26	2.88	0.031
Paid close attention						
Baseline	2.64	2.42	2.63	2.59	2.61	
Follow-up	2.80	2.66	2.97	2.69	2.84	<0.001
Thought about warnings						
Baseline	2.61	2.30	2.52	2.54	2.53	
Follow-up	2.74	2.60	2.76	2.81	2.74	<0.001
Talked about warnings						
Baseline	2.06	1.67	2.01	2.29	2.03	
Follow-up	2.28	2.06	2.44	2.54	2.34	<0.001
Not had a cigarette						
Baseline	NA	NA	2.20	1.46	2.04	
Follow-up	NA	NA	2.64	1.60	2.46	<0.001
Had a cigarette						
Baseline	NA	NA	1.22	1.67	1.32	
Follow-up	NA	NA	1.15	1.66	1.24	NS
Students who had a cigarette in past 12 months						
Thought about quitting						
Baseline	NA	NA	2.44	2.42	2.43	
Follow-up	NA	NA	2.79	2.59	2.73	<0.001
Image of the cigarette pack†						
Positive						
Baseline	1.94	2.31	2.45	2.77	2.30	
Follow-up	1.68	2.07	2.01	2.33	1.91	<0.001
Negative						
Baseline	3.31	3.09	2.91	2.56	3.02	
Follow-up	3.63	3.34	3.31	3.12	3.43	<0.001

*Five-point response scale used: (1) 'never' to (5) 'every time I see them'. †Mean of four items assessed on five-point scale: 1, strongly disagree to 5, strongly agree. Higher score indicates stronger agreement. NA: not available; NS: not significant.

introduction of graphic warning labels increased the frequency of experimental and established smokers thinking about quitting and forgoing cigarettes. As at follow-up, talking about the warning labels and forgoing cigarettes were associated with lower smoking intentions, increasing cognitive processing of the warning labels may help to reduce adolescents' smoking intentions. These results are in line with findings from research examining the impact of graphic health warning labels on adult smokers' behaviours and suggest that graphic health warnings can have an effect on the smoking behaviours of adolescents.

In a longitudinal study examining the impact of small text-based warning labels, Robinson & Killen [9] found that students who smoked were more aware of the warning labels and that awareness predicted increased smoking in the future. While these authors concluded that warning labels were ineffective for reducing adolescent smoking, given that they studied small text-based warning labels, their results might indicate simply that only adolescents involved with smoking would be familiar with them. In support of this, Robinson & Killen's longitudinal association was found only for students who smoked at baseline [9]. Our study also found that compared to never smokers, established smokers were more aware of the warning labels and talked about them more. This might suggest that health warning labels on cigarette packs are most effective at reaching people currently involved with smoking and show a limitation of research examining the impact of graphic warning labels on smoking-related cognitions among both smokers and non-smokers. However, our study also showed that a

Table 4 Regression analyses examining associations between intention to smoke in next 12 months and level of processing of health warning labels and image associated with the pack for students who had seen the new warning labels at follow-up ($n = 1435$).

	Intention to smoke Follow-up (2006) For those who saw new health warnings*		
	B	*se*	*P-value*
Read warnings†	0.00	(0.03)	0.87
Paid attention to warnings†	0.02	(0.03)	0.51
Thought about warnings†	0.02	(0.02)	0.26
Talked about warnings†	–0.06	(0.02)	0.03
Not had a cigarette†	–0.06	(0.02)	0.003
Had a cigarette†	0.23	(0.11)	0.04
Positive image of pack‡	0.11	(0.06)	0.05
Negative image of pack‡	–0.08	(0.04)	0.04
Friends' smoking§	0.10	(0.02)	<0.001
Mother's smoking¶	–0.02	(0.06)	0.75
Father's smoking¶	–0.07	(0.05)	0.17
Smoked in past week	1.17	(0.17)	<0.001
Smoking history			
Just a few puffs	0.24	(0.06)	0.001
1–9 cigs	0.56	(0.11)	<0.001
10–99 cigs	1.22	(0.11)	<0.001
100 or more cigs	1.58	(0.24)	<0.001
Age	–0.07	(0.01)	<0.001
Sex	0.17	(0.04)	<0.001

*Intention measured on a seven-point scale with higher scores indicating stronger intention to smoke in the next 12 months. †Five-point scale used: 1, 'never' to 5, 'every time I see them'. ‡Higher score indicates stronger agreement. Students who could not comment scored 3, 'not sure'. §Smoking by friends treated as linear variable and measured on five-point scale: 0 = no friends smoke to 5 = five or more friends smoke. ¶Mother or father smoking coded 1, no smoking coded 0.

large proportion of susceptible non-smokers had seen graphic health warnings on cigarette packs 6 months after their introduction. As this group is vulnerable to smoking uptake, there is value in examining the impact of graphic health warnings on the cognitions and intentions of this group of non-smokers. We found that warning labels that become a topic of conversation among adolescents and that increase the likelihood of adolescents forgoing cigarettes are associated with lower smoking intentions. As our results showed that graphic health warning labels increased both talking about the warning labels and forgoing cigarettes, it is possible that the introduction of graphic warning labels may lead to a reduction in adolescent smoking.

It has been suggested that warning labels educate smokers about the health risks associated with smoking [2,7]. The only increase we found in the proportion of students recognizing different health risks were for two new warning labels: 'smoking causes mouth cancer' and 'smoking causes peripheral vascular disease'. These increases were found regardless of whether students saw the advertisements promoting these warning labels and contrast with the lack of change in agreement that 'smoking causes emphysema', another new health warning. The pictures accompanying the mouth cancer and peripheral vascular disease warnings contained realistic but hard-hitting images of these health risks compared with the images associated with the other warning labels. Hard-hitting images may be most effective at increasing adolescents' awareness of the risks of smoking. Our finding, that awareness of the health risk was greater among students who saw the advertisements promoting these messages, suggests that promoting the health warnings through television advertisements is an excellent strategy for reaching adolescents.

Cigarette packs have been referred to as 'badge products', meaning that the user associates themselves with the brand's image [20]. Our finding that positive attitudes towards the image of a cigarette pack increased smoking intentions suggests that these images are still attracting adolescents to smoking. Introduction of the graphic warning labels reduced the positive and increased the negative images that adolescents associate with cigarette packs. Associating negative images with the cigarette pack reduced smoking intention at baseline and at follow-up. Other research has shown that graphic health warnings help to create a more negative image of a smoker [22]. One way in which graphic health warnings may reduce smoking among adolescents is by disrupting the positive image around smoking that tobacco companies try to create and maintain through their marketing strategies [20].

It has been suggested that rather than producing change in attitudes towards smoking or quitting behaviour, messages accompanied by images that attempt to produce a negative visceral response, such as graphic health warnings, may produce a defensive reaction in smokers, including paying less attention to these messages [23]. In general, our findings suggest that the graphic health warnings introduced in 2006 did not provoke this response in adolescent smokers. Adolescents with smoking experience thought and talked about the messages at least as much as non-susceptible never smokers. In addition, adolescents with smoking experience responded to the graphic warnings by not having a cigarette and thinking about quitting more frequently at follow-up than at baseline. These findings suggest that students involved with smoking were processing the warning label messages. Our results are in line with findings from studies of adult smokers following the introduction of graphic health warning labels [7] and other work

showing that adolescents are responsive to anti-tobacco advertisements that convey messages about the serious health consequences of smoking [24,25].

The study has a number of limitations. First, because the follow-up study was conducted after a mass media campaign promoting the health warnings, we are not able to determine conclusively the sole effect of the warning labels on adolescents' smoking behaviours. Secondly, we looked cross-sectionally at the association between cognitive processing of the warning labels and smoking intentions. Ideally, longitudinal analyses would be conducted to determine if the graphic warning labels altered smoking intentions. Thirdly, we had relatively few established smokers in our sample and this may have reduced statistical power to detect interaction effects between smoking stage and study period. Thus, while our data suggest that the increases in processing of the warning labels were consistent across smoking groups, this finding needs confirmation in studies with larger numbers of established smokers.

Despite these limitations, the present study provides much-needed information on the impact of graphic health warnings on cigarette packs on adolescents. Our finding that adolescents report attending to these warnings, talking about them and forgoing cigarettes because of them suggests that graphic warning labels as part of a comprehensive tobacco control programme that includes well-funded antismoking mass media campaigns, increased taxes on tobacco products, restrictions on smoking in public places and removal of all tobacco advertising can influence adolescents' smoking-related behaviours. Tobacco control professionals should ensure that messages and images used in graphic health warning labels evoke a strong negative visceral response in smokers and non-smokers and detract from the potential attractiveness of cigarette packs.

Declarations of interest

None.

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