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Centre for Behavioural
Research in Cancer, Cancer
Council Victoria, Melbourne,
Australia

Correspondence to
Associate Professor Victoria
White, Centre for Behavioural
Research in Cancer, Cancer
Council Victoria, 615 St Kilda
Road, Melbourne VIC 3004,
Australia; vicki.white@
cancervic.org.au

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Do larger graphic health warnings on standardised cigarette packs increase adolescents' cognitive processing of consumer health information and beliefs about smoking-related harms?

Victoria White, Tahlia Williams, Agatha Faulkner, Melanie Wakefield

ABSTRACT

Objective To examine the impact of plain packaging of cigarettes with enhanced graphic health warnings on Australian adolescents' cognitive processing of warnings and awareness of different health consequences of smoking.

Methods Cross-sectional school-based surveys conducted in 2011 (prior to introduction of standardised packaging, $n=6338$) and 2013 (7–12 months afterwards, $n=5915$). Students indicated frequency of attending to, reading, thinking or talking about warnings. Students viewed a list of diseases or health effects and were asked to indicate whether each was caused by smoking. Two—'kidney and bladder cancer' and 'damages gums and teeth'—were new while the remainder had been promoted through previous health warnings and/or television campaigns. The 60% of students seeing a cigarette pack in previous 6 months in 2011 and 65% in 2013 form the sample for analysis. Changes in responses over time are examined.

Results Awareness that smoking causes bladder cancer increased between 2011 and 2013 ($p=0.002$). There was high agreement with statements reflecting health effects featured in previous warnings or advertisements with little change over time. Exceptions to this were increases in the proportion agreeing that smoking was a leading cause of death ($p<0.001$) and causes blindness ($p<0.001$). The frequency of students reading, attending to, thinking or talking about the health warnings on cigarette packs did not change.

Conclusions Acknowledgement of negative health effects of smoking among Australian adolescents remains high. Apart from increased awareness of bladder cancer, new requirements for packaging and health warnings did not increase adolescents' cognitive processing of warning information.

INTRODUCTION

Graphic health warnings (GHWs) were first introduced on tobacco products in Australia in 2006, with the warnings required to cover 30% of a cigarette pack's front and 90% of the cigarette pack's back.¹ Coinciding with the full implementation of Australia's *Tobacco Plain Packaging Act 2011*² in December 2012, a new Consumer Information Standard³ was introduced requiring a new set of GHWs. The new GHWs included information about several health effects not covered in previous warnings (eg, kidney and bladder cancer, and effects on teeth and gums) and revised images for previously used health warnings. The new Standard also

required the size of GHW on cigarette packs to increase to 75% of the front-of-pack (with the size of the back-of-pack GHW remaining 90%) and a new set of GHW. With the implementation of the Tobacco Plain Packaging Act and this Standard, Australia became the first country in the world to have large front-of-pack GHWs on tobacco products with standardised packaging design (see Scollo *et al*⁴ for details of new packaging requirements).

Owing to the high visibility of cigarette packs, GHWs have the potential to communicate the health effects of smoking to a broad audience including to adolescents.^{5–6} Packaging's influence on adolescents' awareness of health warnings has been investigated since the early 1990s.⁷ An early study, conducted when health warnings on cigarette packs were generally small and text-based, found that plain packaging only influenced recall of warnings when the cigarette packs used were unfamiliar, with greater recall of warnings found for plain packs of unfamiliar cigarette brands.⁷ Recent qualitative studies (conducted in an era of larger and pictorial warnings) have suggested that plain packaging will increase the noticeability, believability and seriousness of health warnings among adolescents.^{5–8} However, as findings from experimental studies have been mixed, this may not be the case.⁹ An early experimental study found a higher proportion of adolescents recalled two of three text-based warnings when presented on a plain pack.¹⁰ An eye movements tracking study found that while packaging did not influence attention paid to warnings among adolescents who had never smoked, it did influence adolescents who had smoked, with greater attention given to warnings on plain packs.¹¹ However, another experimental study did not find a difference in adolescents' recall of health warnings regardless of whether they were presented on a plain or fully branded pack or whether the warning label was large or small.¹² To date, no study has examined adolescents' responses to GHWs on plain cigarette packs once this packaging regulation has been introduced into a country.

The present study investigates the impact of Australia's new cigarette packaging on the frequency of adolescents attending, reading, talking and thinking about the warnings. These behaviours are considered indicators of cognitive processing, and greater cognitive processing has been positively associated with quit attempts among adult smokers.^{13–14} The introduction of GHWs covering 30% of the front of branded cigarette packs in



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2006 increased Australian adolescents' cognitive processing of warning labels.⁶ However, recent research has shown that this increase diminished after 5 years' exposure to GHWs, with adolescents' cognitive processing of GHWs in 2011 similar to pre-GHW levels.¹⁵ This may reflect a process of habituation, which suggests that attention to a specific object or stimuli will reduce with repeated exposure due to its increasing familiarity.^{16–17} The changes to both cigarette packaging and GHWs introduced in Australia in 2012 may interrupt the habituation process. In the current paper, we use data collected from surveys of adolescents conducted in the year before the new cigarette packaging was introduced (2011) and in the 7–12 months after its introduction (2013) to examine whether the introduction of the new tobacco packaging in Australia increased adolescents' cognitive processing of warning labels and awareness of health risks associated with smoking among students who had seen a cigarette pack in the previous 6 months.

METHODS

Study overview and design

The current study used data from cross-sectional school-based surveys of adolescents in two Australian states conducted in 2011 and 2013. The 2011 data come from the states' component of a national triennial survey of a representative sample of Australian students aged 12–17 years in year levels 7–12. The 2013 survey was separate from the national study, although it drew on the procedures and samples of the 2011 survey. Both surveys had institutional ethics approval and approvals from the appropriate school authorities. The sample and procedures used for this study have been described elsewhere.¹⁸ A brief description is provided here.

School samples

2011 Survey

Schools were randomly selected from the three main Australian education sectors (government, Catholic and independent) to ensure proportional representation. Principals consented to study participation and when a school declined, it was replaced with the school geographically closest to the original school within the same education sector. We aimed to recruit 117 schools from the two states. To achieve this, we approached 324 schools with 97 schools agreeing to study participation (30% response rate). Surveying took place between June and December in 2011.

2013 Survey

This study aimed to survey students from the 97 secondary schools participating in the 2011 survey. School principals were sent an invitation letter seeking consent for study participation. Fifty-eight schools agreed to participate (60%). When a school refused, a replacement school selected from the list of replacement schools drawn for the 2011 survey was approached. Sixty-three replacement schools were approached and 24 schools agreed (response rate 38%), giving a total of 82 schools participating in the 2013 survey. Data collection occurred from June to November 2013.

Student selection

Schools were approached regarding surveying one class of students from each of years 7–10 (age 12–15) or two classes of students from each of years 11 and 12 (age 16 and 17). Researchers worked with each school to ensure selected classes were representative of all classes (eg, no electives). With an average of 21 students per class,¹⁹ we aimed to survey approximately 80 students per school.

Consent procedures

A 'passive' parental consent procedure was used for the 2011 survey and in one state in 2013. In this procedure, parents are informed of the study and tell the school if they do not want their child to take part. In 2013, an 'active' parental consent procedure (parents informed the school that their child could or could not take part in survey) was used in all government and Catholic schools in the second state. In all surveys, students consented to survey participation. To examine the impact of the active parental consent on student participation, we examined the proportion of schools where fewer than 40 students completed the survey. In the state where parental consent procedures did not change, the proportion of schools where fewer than 40 students took part in the survey decreased between 2011 (16%) and 2013 (6%; $p=0.06$) while in the other state the proportion increased (2011: 26%; 2013: 63%, $p=0.003$). Previous research suggests that although active parental consent reduces participation numbers, overall substance use estimates are similar to when passive parental consent is used.²⁰

Procedure for all surveys

On an agreed day external research staff attended the school to administer the pencil-and-paper questionnaire to the preselected classes of students, during school time. Students without parental consent were excluded from the survey group. After working through a practice survey with research staff, students gave consent for their participation in the study and were provided with the survey. Students worked independently and completed the survey anonymously.

Measures

Items used for this investigation were taken from larger surveys in both years.

Recency of seeing cigarette packs

In both surveys, students indicated when they last saw a pack of cigarettes (response options: 'within the last 6 months', 'more than 6 months ago' or 'never').

Perceptions of health consequences of smoking

In both surveys, students were presented with the same list of 18 items and asked to indicate whether they agreed or disagreed that they were caused by smoking, using a five-point Likert scale. Fifteen items—which are the focus of this paper—reflected the GHWs appearing on cigarette packs since 2006, warnings that were used in post plain packaging implementation or tobacco-related illnesses promoted in tobacco control advertising since 1997 or earlier. The GHWs used from 2006 to 2012 were a mix of completely new messages and re-presentations of text-warning labels used between 1995 and 2005. Similarly, the GHWs introduced with plain packaging in December 2012 were a mix of new and old messages. Table 1 shows the text messages in each of the four sets of seven GHWs (sets rotating roughly every 12 months) used between 2006 and 2013. Table 1 also indicates which warnings used new or similar images or topics post plain packaging, and a visual comparison is provided at <https://www.cancervic.org.au/plainfacts/browse.asp?ContainerID=packagingexamples>. Text-only health warnings on tobacco products before 2006 included: 'smoking causes lung cancer', 'smoking causes heart disease', 'smoking when pregnant harms your baby', 'your smoking can harm others' and 'smoking is addictive'. Health messages conveyed in tobacco control advertisements before and after 2006 included smoking: clogs arteries; causes blindness; emphysema; lung cancer and heart disease.

Table 1 Health effects depicted on cigarette and tobacco packaging by graphic health warnings in different time periods in Australia

Set B* 2006 pre-PP 1 March 2011–28 February 2012	Set A 2006 pre-PP 1 November 2011–30 November 2012	Set 1 post-PP 1 October 2012–30 November 2013	Set 2 post-PP From 1 August 2013
Smoking is addictive	Gangrene	Gangrene†	Damage to teeth/gums§
Stroke	Mouth cancer/throat cancer	Mouth cancer†	Stroke‡
Blindness	Artery	Blindness†	Throat cancer‡
Harm to unborn babies	Harm to children	Harm to unborn babies‡	Harm to children‡
Heart disease	Death	Lung cancer‡	Death‡
Lung cancer	Emphysema	Emphysema†	Heart disease‡
Tobacco smoke is toxic	Quitting will improve your health	Quitting will improve your health‡	Kidney and bladder cancer¶

*Set A and set B: each consisted of seven graphic health warnings with the sets rotated roughly every 12 months.

†Same topic, same or similar image.

‡Same topic, new image.

§New topic, similar image to a related harm.

¶New topic, new image.

PP, plain packaging.

Cognitive processing of warnings

Those seeing a cigarette pack in the previous 6 months indicated how frequently they: read; paid close attention to; thought about and talked about the warning labels using a five-point scale: (1) 'never'; (2) 'once or twice'; (3) 'sometimes'; (4) 'often' and (5) 'every time I see them'. In addition, students indicated how frequently they had not had a cigarette because of the warnings. Students who had smoked in the previous 12 months were asked how frequently they thought about quitting smoking because of the warnings. Responses were made on a consistent five-point scale.

Student characteristics

Students indicated whether they had ever smoked (no never; yes, just a few puffs; yes, but less than 10 cigarettes; yes, more than 10 but less than 100 cigarettes; yes, more than 100 cigarettes in lifetime); whether they had smoked on each of the previous 7 days and whether they intended to smoke in the next 12 months (7-point scale ranging from certain not to smoke to certain to smoke). We classified students into a four-level smoking status variable based on their answers to these questions. The smoking status levels were: *non-susceptible never-smokers* (NSNS) who had never smoked a cigarette (not even a puff) and were certain not to smoke in the next 12 months; *susceptible never-smokers* (SNS) (not even a puff) who were not certain that they would not smoke in the next 12 months; *experimental smokers* (ES) had had at least a puff of a cigarette, but had not smoked in the previous 7 days and *current smokers/established smokers* (CS) had smoked in the previous 7 days or had smoked at least 100 cigarettes in their lifetime. The classification used here is similar to that reported by others.^{21 22}

Students indicated whether their mother and/or father smoked (yes/no) and indicated the number of smokers among their five closest friends (0–5). Variables indicating that at least one parent smoked and that at least one friend smoked were calculated. Students also indicated their sex and age. Education sector of the school attended (government, Catholic, independent) was recorded.

Statistical analyses

To correct for any oversampling or undersampling of students from specific age, sex and education sector groupings within a state, the sample was weighted to bring the sample distribution into line with the school enrolment data for the two states.²³ χ^2 Tests examined the similarity of the sample in the two surveys.

Data from students who had seen a cigarette pack in the previous 6 months are used. Logistic regression analyses compared proportions across the two surveys. Linear regression analyses examined change in the cognitive processing variables between the surveys. In these analyses, each outcome variable was regressed onto survey period and the control variables age, sex, school type, state and smoking status. An interaction term between survey period and smoking status was fitted to determine if the effect of survey period was consistent across smoking stage. Students with missing data on variables were excluded from relevant analyses. All analyses were adjusted for clustering of students within school and SEs obtained that were robust to potential non-independence of students. The statistical package STATA²⁴ was used for analysis to accommodate the complex sample design.

Sensitivity analyses examined whether the change in parental consent procedures in one state influenced findings, by repeating the analyses described above using data only from the state where there had been no change in parental consent procedures. Sensitivity analyses produced the same pattern of results as reported below.

RESULTS

Sixty-one per cent of students in 2011 and 65% in 2013 had seen a cigarette pack in the previous 6 months (table 2). Characteristics of the sample seeing a cigarette pack are shown for the weighted and unweighted data for the two surveys (table 2). While in the unweighted data, there were some significant differences in sex and age characteristics of students seeing cigarette packs between 2011 and 2013, these differences were not significant in the weighted data set. The proportion of students reporting that none of their five closest friends smoked was significantly greater in 2013 than 2011 in the weighted and unweighted data. In both survey years, the majority of students were NSNS. The proportion of NSNS increased between the two surveys for both the weighted and unweighted data. The proportion of CS and ES decreased between 2011 and 2013 for both the weighted and unweighted data. Weighted data are reported for the rest of the paper.

Awareness of health risks of smoking

Table 3 shows the proportion of students who had seen a cigarette pack in the previous 6 months agreeing that smoking causes bladder cancer, kidney disease and diseases of the gums and teeth, all items reflecting new health warnings introduced with

Table 2 Proportion of sample seeing cigarette packs in the previous 6 months and characteristics of these students in 2011 and 2013 surveys

	Unweighted data		p Value	Weighted data		p Value
	2011	2013		2011	2013	
Total number of students surveyed (N)	6338	5915		6338	5984	
Saw cigarette packs in previous 6 months: N (%)	3888 (61)	3852 (65)	<0.001	3802 (60)	3886 (65)	0.004
Among students seeing packs in previous 6 months						
Sex (% males)	43	49	<0.001	45	50	0.26
Age			<0.001			0.79
12–15-year olds	62	69		66	68	
16–17-year olds	38	31		34	32	
Mother smokes (% yes)	27	25	0.04	27	24	0.22
Father smokers (% yes)	33	31	0.14	33	29	0.083
Percentage of students with no friends who smoke	61	71	<0.001	64	72	0.003
Smoking status (%)						
NSNS	56	65	<0.001	58	66	0.003
SNS	9	9	0.48	9	9	0.87
ES	23	18	<0.001	22	17	0.002
CS	12	8	<0.001	11	7	0.008

CS, smoking in past week/established smokers; ES, experimental smokers; NSNS, non-susceptible never-smokers; SNS, susceptible never-smokers.

the standardised packs. The proportion agreeing that smoking causes bladder cancer increased ($p=0.002$), with awareness not varying by smoking status ($p=0.40$). There was a small increase in agreement that smoking causes kidney disease but this was not statistically significant ($p=0.18$). Agreement with the statement that smoking causes diseases of teeth and gums was high in both surveys and did not change.

Agreement with statements reflecting diseases or conditions featured in previous warnings was generally very high and for most items there was no change (table 4). Exceptions were increases in the proportion of students agreeing that smoking was a leading cause of death ($p<0.001$) and causes blindness ($p<0.001$). Smoking status was associated with agreement for

nine health consequences statements (table 4). For seven statements (lung cancer, heart disease, unborn babies, leading cause of death, mouth cancer, stroke and diseases of fingers and toes), agreement was higher among NSNS than CS. For two items (emphysema and blindness), agreement was higher among CS than NSNS. The two significant interactions between year and smoking status occurred for items where there was no main effect of year (mouth cancer and emphysema).

Cognitive processing of warnings

Among students who had seen a cigarette pack in the previous 6 months, there was no significant change in the cognitive processing items between 2011 and 2013 (table 5). While there was

Table 3 For health messages introduced post plain packaging, unadjusted proportion (95% CI) of students agreeing or strongly agreeing that smoking causes these diseases by year and smoking status among students who had seen a cigarette pack within the previous 6 months (weighted data)

							χ^2 Statistic and p values*		
	Years GHW in circulation	NSNS % (95% CI)	SNS % (95% CI)	ES % (95% CI)	CS % (95% CI)	Total % (95% CI)	Year	Smoking status	Interaction of year and smoking status
2011 (weighted N)		(2150)	(349)	(830)	(405)	(3733)			
2013 (weighted N)		(2558)	(253)	(653)	(286)	(3851)			
Diseases of the gums									
2011 (%)	Message from 1/8/2013	88 (86 to 89)	84 (81 to 88)	89 (87 to 91)	86 (82 to 89)	87 (86 to 89)	$\chi^2_{(1)}=0.42$, $p=0.52$	$\chi^2_{(3)}=13.86$, $p=0.003$	$\chi^2_{(3)}=3.72$, $p=0.29$
2013 (%)		87 (85 to 88)	84 (80 to 87)	89 (87 to 91)	85 (81 to 89)	87 (85 to 88)			
Kidney disease									
2011 (%)	Message from 1/8/2013	78 (76 to 80)	77 (73 to 81)	78 (76 to 81)	75 (71 to 79)	78 (76 to 79)	$\chi^2_{(1)}=1.77$, $p=0.18$	$\chi^2_{(3)}=6.51$, $p=0.09$	$\chi^2_{(3)}=2.52$, $p=0.47$
2013 (%)		80 (78 to 83)	79 (75 to 83)	80 (78 to 83)	77 (73 to 81)	80 (78 to 82)			
Bladder cancer									
2011 (%)	Message from 1/8/2013	63 (61 to 65)	61 (57 to 66)	64 (60 to 67)	63 (58 to 68)	63 (61 to 65)	$\chi^2_{(1)}=9.57$, $p=0.002$	$\chi^2_{(3)}=2.98$, $p=0.40$	$\chi^2_{(3)}=4.13$, $p=0.25$
2013 (%)		69 (65 to 72)	67 (63 to 71)	69 (66 to 73)	69 (64 to 73)	69 (66 to 71)			

In total, 104 students had missing data on the smoking status variable and were excluded from analyses. Missing data on the different items over the two surveys ranged from 6 to 20.

*Analyses adjusted for covariates of sex, age, school education sector, state and smoking status.

CS, smoking in past week/established smokers; ES, experimental smokers; NSNS, non-susceptible never-smokers; SNS, susceptible never-smokers.

Table 4 Unadjusted proportion (95% CIs) of students agreeing or strongly agreeing that smoking causes different diseases promoted in GHWs or tobacco control advertising from 2006 onwards by survey year and smoking status among students who had seen a cigarette pack within the previous 6 months (weighted data)

Smoking...	Years GHW used prior to plain packaging introduction	NSNS % (95%CI)	SNS % (95%CI)	ES % (95%CI)	CS % (95%CI)	Total % (95%CI)	χ^2 Statistic and p value*		
							Year	Smoking status	Interaction of year and smoking status
2011 (weighted N)		(2150)	(349)	(830)	(405)	(3733)			
2013 (weighted N)		(2558)	(253)	(653)	(286)	(2851)			
Not a plain packaging health warning									
Is addictive	2007, 2009, 2011								
2011 (%)		88 (87 to 90)	90 (87 to 92)	90 (88 to 92)	89 (87 to 92)	89 (88 to 90)	$\chi^2_{(1)}=1.51$, p=0.22	$\chi^2_{(3)}=0.50$, p=0.92	$\chi^2_{(3)}=6.37$, p=0.01
2013 (%)		87 (86 to 89)	88 (86 to 91)	89 (87 to 91)	88 (85 to 92)	88 (86 to 89)			
Is toxic (from tobacco smoke)	2007, 2009, 2011								
2011 (%)		81 (79 to 83)	77 (73 to 80)	84 (82 to 86)	86 (83 to 89)	82 (80 to 83)	$\chi^2_{(1)}=0.45$, p=0.50	$\chi^2_{(3)}=5.24$, p=0.16	$\chi^2_{(3)}=5.34$, p=0.15
2013 (%)		80 (78 to 83)	76 (72 to 80)	84 (81 to 86)	86 (82 to 89)	81 (79 to 83)			
Clogs arteries	2006, 2008, 2010, 2012								
2011 (%)		81 (79 to 83)	81 (77 to 84)	84 (82 to 87)	84 (80 to 87)	82 (80 to 84)	$\chi^2_{(1)}=2.23$, p=0.14	$\chi^2_{(3)}=1.21$, p=0.75	$\chi^2_{(3)}=2.19$, p=0.53
2013 (%)		79 (77 to 82)	79 (76 to 82)	83 (80 to 86)	82 (78 to 86)	80 (78 to 82)			
Post-plain packaging									
Set 1 warning from 1 October 2012									
Causes diseases in toes and fingers (gangrene)	2006, 2008, 2010, 2012								
2011 (%)		88 (86 to 89)	89 (86 to 91)	89 (87 to 91)	84 (80 to 88)	88 (86 to 89)	$\chi^2_{(1)}=0.00$, p=0.97	$\chi^2_{(3)}=18.03$, p<0.001	$\chi^2_{(3)}=2.34$, p=0.50
2013 (%)		88 (85 to 91)	89 (86 to 92)	90 (87 to 92)	85 (80 to 89)	88 (86 to 91)			
Causes mouth cancer	2006, 2008, 2010, 2012								
2011 (%)		94 (93 to 95)	93 (91 to 96)	95 (94 to 97)	92 (90 to 94)	94 (93 to 95)	$\chi^2_{(1)}=3.33$, p=0.07	$\chi^2_{(3)}=18.29$, p<0.001	$\chi^2_{(3)}=8.66$, p=0.034
2013 (%)		96 (95 to 96)	95 (93 to 97)	96 (95 to 98)	94 (91 to 96)	95 (95 to 96)			
Causes blindness	2007, 2009, 2011								
2011 (%)		50 (47 to 52)	45 (40 to 50)	49 (46 to 53)	56 (52 to 61)	50 (47 to 52)	$\chi^2_{(1)}=42.44$, p<0.001	$\chi^2_{(3)}=8.14$, p=0.043	$\chi^2_{(3)}=0.85$, p=0.84
2013 (%)		60 (58 to 63)	55 (50 to 60)	60 (57 to 63)	67 (62 to 71)	60 (58 to 63)			
Harms unborn babies	2007, 2009, 2011								
2011 (%)		95 (94 to 96)	92 (89 to 94)	94 (93 to 96)	91 (88 to 94)	94 (93 to 95)	$\chi^2_{(1)}=0.84$, p=0.36	$\chi^2_{(3)}=25.81$, p<0.001	$\chi^2_{(3)}=3.08$, p=0.38
2013 (%)		94 (93 to 95)	91 (88 to 93)	94 (92 to 95)	90 (86 to 94)	93 (92 to 95)			
Causes lung cancer	2007, 2009, 2011								
2011 (%)		98 (98 to 99)	98 (96 to 99)	97 (96 to 98)	94 (92 to 96)	97 (97 to 98)	$\chi^2_{(1)}=1.37$, p=0.24	$\chi^2_{(3)}=37.45$, p<0.001	$\chi^2_{(3)}=0.82$, p=0.84
2013 (%)		98 (97 to 98)	97 (96 to 98)	96 (95 to 97)	93 (90 to 96)	97 (96 to 98)			
Causes emphysema	2006, 2008, 2010, 2012								
2011 (%)		82 (80 to 84)	79 (75 to 83)	89 (87 to 91)	89 (87 to 92)	84 (82 to 86)	$\chi^2_{(1)}=0.58$, p=0.45	$\chi^2_{(3)}=14.78$, p=0.002	$\chi^2_{(3)}=7.97$, p=0.047
2013 (%)		83 (81 to 85)	80 (77 to 84)	90 (88 to 92)	90 (88 to 93)	85 (83 to 86)			
Post-plain packaging									
Set 2 warning from 1 August 2013									
Is a leading cause of death	2006, 2008, 2010, 2012								
2011 (%)		76 (74 to 78)	70 (66 to 75)	72 (69 to 75)	71 (67 to 76)	74 (72 to 76)	$\chi^2_{(1)}=18.82$, p<0.001	$\chi^2_{(3)}=10.35$, p=0.016	$\chi^2_{(3)}=3.55$, p=0.31
2013 (%)		81 (79 to 83)	76 (72 to 79)	77 (75 to 80)	77 (73 to 81)	80 (78 to 81)			
Increase the risk of having a heart attack	2006, 2008, 2010, 2012								
2011 (%)		92 (91 to 93)	88 (86 to 91)	92 (90 to 93)	88 (85 to 90)	91 (90 to 92)	$\chi^2_{(1)}=1.87$, p=0.17	$\chi^2_{(3)}=28.34$, p<0.001	$\chi^2_{(3)}=1.93$, p=0.59
2013 (%)		91 (90 to 92)	87 (85 to 90)	91 (89 to 93)	87 (84 to 90)	90 (89 to 91)			
Doubles risk of stroke	2007, 2009, 2011								
2011 (%)		83 (81 to 85)	81 (77 to 84)	83 (80 to 86)	81 (76 to 85)	83 (81 to 84)	$\chi^2_{(1)}=0.13$, p=0.72	$\chi^2_{(3)}=8.57$, p=0.036	$\chi^2_{(3)}=2.93$, p=0.40
2013 (%)		84 (82 to 87)	82 (78 to 85)	84 (81 to 86)	82 (77 to 86)	84 (81 to 86)			

Items grouped according to whether they were used as a warning with the introduction of plain packaging.

In total, 104 students had missing data on the smoking status variable and were excluded from analyses. Missing data on the different items over the two surveys ranged from 5 to 74.

*Analyses adjusted for covariates of sex, age, school education sector, state and smoking status.

CS, smoking in past week/established smokers; ES, experimental smokers; GHW, graphic health warning; NSNS, non-susceptible never-smokers; PP, plain packaging; SNS, susceptible never-smokers.

some difference in these items by smoking status, there was no significant interaction between survey year and smoking status (table 5).

Among ES and CS, there was no significant change in the frequency of not having a cigarette because of the health warnings ($p=0.52$). Among students who had smoked in the previous 12 months, there was no significant change in the frequency of thinking about quitting ($p=0.28$). There was no interaction between year and smoking status for either item (table 5).

DISCUSSION

With around 60% of students surveyed seeing cigarette packs in the preceding 6 months, GHWs on tobacco packs have the potential to reach a large proportion of adolescents. Our study found the introduction of the new cigarette packaging in late 2012 did not have an immediate impact on the cognitive processing of GHW among adolescents who had seen a cigarette pack in the previous 6 months. However, we found a significant increase in the proportion of these adolescents agreeing that smoking causes bladder cancer, a cancer included in the only completely new health warning introduced with the new cigarette packaging. This increase is notable given that the warning only started appearing on significant numbers of packs quite late in our survey period.

We have shown previously that 6 months after the introduction of GHWs in 2006, adolescents' cognitive processing of warnings had increased from pre-GHW levels.⁶ However, we

have also found that this increase dissipated after 5 years of exposure, with cognitive processing levels in 2011 similar to pre-GHW levels.¹⁵ The current study suggests that larger front-of-pack GHWs on plain packs do not increase cognitive processing of warnings among adolescents who have already been exposed to similarly styled GHWs for about 7 years.

Our findings are in line with previous studies suggesting that familiarity may reduce the effectiveness of plain packaging to increase adolescents' attention to warning labels.^{7 12} For instance, an experimental study involving Australian adolescents who had been exposed to 30% front-of-pack GHWs for several years found no effect of packaging or warning size on warning recall.¹² Of the 14 GHWs used on the new packaging, 9 featured a previously used message with an updated image and 3 featured messages and images used previously. The lack of change in the size of warning labels on the back-of-packs may also have contributed to a sense of familiarity regarding the warnings. All warnings on the new tobacco packaging promoted relatively long-term health consequences of smoking. It has been suggested that warnings promoting the more immediate health or social consequences of smoking may be more salient and relevant to young people.²⁵ However, as our previous work has shown an increase in adolescents' cognitive processing of warnings after the introduction of GHWs that promoted long-term health effects in 2006 with levels remaining elevated in 2008,¹⁵ the use of long-term health effects per se does not limit adolescents' cognitive processing of warnings, at least in the short term. Whether the use of

Table 5 For students who had seen a cigarette pack in past 6 months, mean frequency of reading, attending to, thinking about and talking about health warnings and for students with smoking experience, the frequency of not having a cigarette or thinking about quitting in response to the warnings in 2011 and 2013, by smoking status (weighted data)

	Smoking stage					F statistic and p values*		
	NSNS Mean (SE)	SNS Mean (SE)	ES Mean (SE)	CS Mean (SE)	Total Mean (SE)	Year	Smoking status	Interaction year and smoking status
2011 (weighted N)	(2150)	(349)	(830)	(405)	(3733)	$F(1,183)=$	$F(3,183)=$	$F(3,183)=$
2013 (weighted N)	(2558)	(353)	(653)	(286)	(3851)			
Read warnings								
2011	2.58 (0.04)	2.50 (0.07)	2.51 (0.04)	2.60 (0.06)	2.56 (0.03)	0.03, $p=0.87$	2.74, $p=0.045$	1.07, $p=0.36$
2013	2.57 (0.05)	2.48 (0.07)	2.50 (0.06)	2.59 (0.07)	2.55 (0.04)			
Paid close attention								
2011	2.77 (0.04)	2.59 (0.07)	2.62 (0.05)	2.37 (0.05)	2.68 (0.03)	0.70, $p=0.40$	5.96, $p<0.001$	0.83, $p=0.48$
2013	2.73 (0.05)	2.55 (0.07)	2.58 (0.06)	2.32 (0.06)	2.66 (0.05)			
Thought about warnings								
2011	2.62 (0.04)	2.40 (0.05)	2.53 (0.04)	2.43 (0.06)	2.56 (0.03)	1.91, $p=0.17$	4.64, $p=0.004$	0.41, $p=0.75$
2013	2.68 (0.04)	2.46 (0.06)	2.59 (0.05)	2.49 (0.07)	2.63 (0.04)			
Talk about warnings								
2011	2.06 (0.03)	1.92 (0.05)	2.05 (0.04)	2.12 (0.05)	2.05 (0.02)	0.34, $p=0.56$	4.66, $p=0.003$	1.47, $p=0.22$
2013	2.03 (0.04)	1.89 (0.06)	2.02 (0.04)	2.09 (0.06)	2.02 (0.03)			
Not had a cigarette								
2011	—	—	2.60 (0.06)	1.65 (0.06)	2.29 (0.04)	0.042, $p=0.52$	161.98, $p<0.001$	1.27, $p=0.26$
2013	—	—	2.65 (0.09)	1.69 (0.08)	2.35 (0.08)			
Among students who had smoked in previous 12 months								
Thought about quitting								
2011 (weighted N)			(437)	(364)	(801)	$F(1,175)=$	$F(1,175)=$	$F(1,175)=$
2013 (weighted N)			(403)	(285)	(688)			
2011	—	—	2.58 (0.09)	2.49 (0.06)	2.53 (0.06)	1.16, $p=0.28$	0.67, $p=0.42$	0.94, $p=0.33$
2013	—	—	2.47 (0.08)	2.38 (0.07)	2.42 (0.06)			

Responses measured on a five-point scale from 1 'never' to 5 'every time I see them'.

In total, 104 students had missing data on the smoking status variable and were excluded from analyses. Missing data on the different items over the two surveys ranged from 37 to 131.

*Analyses adjusted for covariates of sex, age, school education sector, state and smoking status.

CS, smoking in past week/established smokers; ES, experimental smokers; NSNS, non-susceptible never-smokers; SNS, susceptible never-smokers.

immediate health effects or social consequences of smoking in GHWs would maintain higher levels of cognitive processing over the long term is not known.

An eye-tracking study has shown that adult smokers spend less time looking at warnings on plain packs than non-smokers²⁶ with a recent eye-tracking study suggesting this is due to smokers attempting to avoid warnings.²⁷ While the lack of change in our cognitive processing indicators may reflect an avoidance response stimulated by the larger GHWs, as cognitive processing in 2013 was the same as in 2011 when warnings covered only 30% of the front-of-pack, our results suggest that the new packaging did not increase avoidant responses.

Field experiments with adult smokers in the UK and France have found that plain packaging increases reading and thinking about warning labels,^{28–29} while not changing the believability and noticeability²⁹ or credibility²⁸ of GHWs. Thinking about warnings was the only cognitive processing item in our study to increase (although not significantly) between 2011 and 2013. It may be that in environments where GHWs on tobacco products are the norm, plain packaging may first stimulate adolescents to think a little more about the warning labels they notice. If this is the case, the non-significant increase we found may indicate that this change was at an early stage when the 2013 survey was conducted suggesting that the increase may strengthen with longer exposure to the new tobacco packaging. However, further research is needed to confirm this suggestion.

The lack of significant change in adolescents' cognitive processing of warning labels is in contrast to findings from several studies of Australian adult smokers. Australian population-based studies of adult smokers have found the proportion of adult smokers having strong cognitive, emotional and avoidant responses to GHWs on cigarette packs increased after the introduction of the new plain tobacco packaging.^{30–31} Wakefield *et al*³¹ (this volume) found that these effects persisted up to a year after the packaging changes, and Brennan *et al*³² (this volume) found cognitive and avoidant responses to health warnings on plain packs predicted quitting thoughts, intentions and attempts 1 month later. The differences in these findings and those for the current study may reflect the greater involvement adult smokers have with smoking compared with adolescents. With their higher daily smoking rate, adult smokers access and use cigarette packs far more frequently than most adolescents. Many adult smokers want to quit³³ and use GHWs for motivation for doing so.³⁴

There was a very high level of prompted agreement with most of the health consequences in 2011, with levels remaining high in 2013. This likely reflects that most of the health consequences assessed had been used in health warnings and/or tobacco control advertising campaigns since 2006, with some warnings used since 1995. There were, however, increases in the proportion of students agreeing that 'smoking is a leading cause of death' and 'smoking causes blindness' statements reflecting two warnings in use since 2006 and 2007, respectively. An increase in the proportion of students agreeing that 'smoking causes blindness' is encouraging as a previous study of Australian students found no change in agreement levels between 2005 (50%), 2008 (53%) and 2011 (52%).³⁵ Whether this increase is due to the new tobacco packaging is not clear, as this health warning was used in a number of tobacco control mass media campaigns between 2011 and 2013.

We found an increase in prompted knowledge of one health consequence of smoking that most closely reflected a completely new GHW introduced with the new packaging—smoking causes bladder cancer. However, we did not find a change in the proportion of students agreeing that smoking causes 'kidney disease', a

message also included in this new warning. The lack of change may be due to the item referring to kidney disease rather than kidney cancer specifically. However, it may also reflect that the messages about smoking causing kidney and bladder cancer were conveyed in one combined warning. As the text relating to bladder cancer was closest to the image used in this GHW, it could be speculated that this aspect of the warning was more prominent to adolescents. The item 'smoking causes diseases of the teeth and gums' did not change, with high levels of agreement in 2011 and 2013. The lack of change may be due to the similarity of the image used for this GHW and that used for the GHW 'smoking causes mouth cancer' between 2006 and 2012. A mouth cancer message additionally featured in a media campaign between 2006 and 2012. It is likely that adolescents understood the earlier health warning message and image to imply that gums and teeth would be affected by mouth cancer.

Several limitations should be noted. The study compares responses from adolescents participating in two cross-sectional surveys and thus does not determine whether the introduction of the new tobacco packaging has changed individuals' knowledge or cognitive processing. However, by ensuring that the students taking part in our two cross-sectional surveys were drawn from the same population and were generally similar on key demographic characteristics, our design provides information regarding whether responses among the target population changed over time, which was the aim of the study. We examined students' self-reported behaviours when seeing cigarette packs rather than assessing actual behaviours. We also examined prompted recall of health consequences of smoking rather than unprompted recall. Unprompted recall generally elicits much lower estimates of awareness of health risks of smoking and provides a more sensitive indication of salient 'top of mind' awareness. However, as the two surveys used the same questions, measurement error associated with survey items should be similar across surveys. In addition, it may be that the regular exposure to messages regarding the many different harms of smoking through both mass media tobacco control campaigns and previous health warnings has created a general belief that smoking causes many, many diseases which leads students to respond positively when presented with a list of diseases. Our follow-up survey was conducted 7–12 months after the introduction of the new tobacco packaging and this may have meant there was insufficient time for the new packaging to influence adolescents. However, an effect on adolescents' cognitive processing of warnings was found 6–9 months after the introduction of GHWs in 2006.⁶ Change in consent procedures in one state meant that some schools surveyed only a small number of students and this could have introduced some bias. However, sensitivity analyses suggested that the change in consent procedures in one state had minimal influence on results.

Despite these limitations, the present study provides new information on the immediate impact of adolescents to larger GHWs on standardised cigarette packs. Our data suggest that when the style and content of most warning messages are familiar to the population, the introduction of plain packaging and larger warnings does not induce adolescents to attend to and process warnings on cigarette packs to a greater extent than when GHWs covered 30% of the front of a fully branded pack. However, the introduction of larger GHWs and plain packaging has reduced positive cigarette pack image and positive brand characteristics among adolescents (this volume).¹⁸ That finding, coupled with those presented here, suggests that the immediate effect of the new tobacco packaging on adolescents has been to reduce pack appeal and to reduce perceived positive brand characteristics.

Continued monitoring of adolescents' responses to GHWs on the new cigarette packs in Australia would show whether adolescents' cognitive processing of GHWs increases with longer exposure.

What this paper adds

- ▶ While the introduction of graphic health warning (GHW) in Australia in 2006 was associated with an increase in adolescents' cognitive processing of warnings, by 2011 cognitive processing levels had returned to pre-GHW levels.
- ▶ Along with the introduction of plain packaging for tobacco products in December 2012, Australia increased the size of front-of-pack GHWs to 75%. While qualitative studies suggest plain packaging increases the noticeability, believability and seriousness of health warnings among adolescents, the evidence from experimental studies is mixed.
- ▶ This study which compares data from surveys of Australian adolescents conducted in 2011 and 2013 showed no change in adolescents' cognitive processing of warnings with the introduction of new cigarette packaging in late 2012.

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Contributors VW and MW designed the study. VW undertook analysis and drafted the manuscript. TW co-ordinated data collection 2013 and AF assisted with data collection in 2011. TW and AF co-ordinated data processing. All authors reviewed and approved the final manuscript.

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Ethics approval The study had ethical approval from the institution of the lead author. State education authorities approved the conduct of the study in both years.

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