

Impact of adding and removing warning label messages from cigarette packages on adult smokers' awareness about the health harms of smoking: findings from the ITC Canada Survey

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ABSTRACT

Introduction Adding messages to cigarette health warning labels (HWLs) about the harms of smoking increases awareness of these health facts, but little is known about the impact of removing messages. This is the first study to directly investigate the impact of adding *and* removing messages from cigarette HWLs on smokers' awareness of harms.

Methods Data were drawn from nine waves of the International Tobacco Control (ITC) Canada Survey, a national representative cohort of adult smokers (n=5863) conducted nearly annually between 2002 and 2013–2014. Two analytical approaches were conducted: generalised estimating equation (GEE) regression models estimated adjusted percentages of correct smoking-related health statements at each wave and segmented regression analyses modelled temporal trends in awareness before and after the revisions by measuring the difference in slopes.

Results Adding messages to HWLs significantly increased awareness that smoking causes blindness (OR=3.36 (95% CI 2.71 to 4.18); p<0.001; estimated increase of 1.01 million smokers in Canada) and bladder cancer (OR=2.14 (95% CI 1.71 to 2.66), p<0.001; estimated increase of 1.09 million smokers). Adding the warning that nicotine causes addiction did not significantly impact smokers' awareness. Removing messages was shown to decrease awareness that cigarette smoke contains carbon monoxide (OR=0.53 (95% CI 0.41 to 0.70), p<0.001; estimated decrease of 342 000 smokers) and smoking causes impotence (p=0.007 for the difference in slopes; estimated decrease of 354 000 smokers).

Conclusions Adding messages to HWLs increases smokers' awareness of health facts, but removing messages decreases awareness. These findings demonstrate the importance of carefully considering the implications of adding and especially removing messages from HWLs and the importance of regularly revising warnings.

INTRODUCTION

Tobacco smoking is the leading cause of preventable morbidity and mortality worldwide. The Global Burden of Disease Study estimated that in 2017, smoking caused 7.1 million deaths and secondhand smoke (SHS) caused an additional 1.2 million deaths.¹ Smoking has been causally linked to diseases in nearly all organs of the body, leading

to numerous cardiovascular diseases, respiratory diseases, cancers and reproductive disorders.²

Reducing smoking prevalence is critical to achieve a relative reduction of 25% in overall mortality from non-communicable diseases (NCDs). This goal cannot be reached without meeting the Global Action Plan target of reducing tobacco use among persons aged 15 years and older by 30%.³ Reducing NCDs, in turn, is a key objective of the Sustainable Development Goals (SDGs), particularly SDG 3, which also calls for the strengthening of the implementation of the WHO Framework Convention on Tobacco Control (FCTC).⁴

Warning populations about the harms of tobacco use remains a primary goal and key strategy to reduce smoking prevalence.⁵ Article 4.1 of the WHO FCTC states that '*every person should be informed of the health consequences, addictive nature and mortal threat posed by tobacco consumption and exposure to tobacco smoke*'.⁶ Increasing awareness of the harms of smoking is particularly important because smokers who report greater knowledge of smoking-related risks are more likely to intend to stop smoking, to attempt to quit and to quit successfully.^{7–12}

Many people, however, are still not fully aware of the wide range of smoking-related health consequences.² Studies have shown that while most people recognise that tobacco use is detrimental to health, many underestimate the risk and are often unable to identify specific health effects.^{13–14} A study conducted among smokers from Canada, the USA, Australia and the UK found that although the majority of smokers acknowledged that smoking causes lung cancer and heart disease, substantially fewer believed that smoking causes stroke, impotence and harm to non-smokers via SHS.¹³

One of the most effective and widespread strategies for enhancing awareness of the risks of smoking is via health warning labels (HWLs) on cigarette packages.^{12–17} With extremely high exposure at the individual and population level, HWLs have a large potential to enhance knowledge of smoking-related health facts.¹⁶ Pictorial warnings that are regularly revised have been shown to be particularly effective. Large pictorial warnings are more likely to capture attention, resulting in greater information processing of content and improved memory of health risks over time.^{11 18–23} A study that evaluated the impact of warnings on the awareness among



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Table 1 Administration dates of the ITC Survey, Waves 1–9

Wave	Survey dates
1	October–December 2002
2	May–September 2003
3	June–December 2004
4	October 2005–January 2006
5	October 2006–February 2007
6	September 2007–February 2008
7	October 2008–February 2009
8	July 2010–June 2011
Revision of warning labels – May 2012	
9	August 2013–May 2014

ITC, International Tobacco Control.

smokers in Australia, Canada and Mexico found greater awareness of health risks in countries where pictorial HWLs were first introduced or recently revised.²⁰

Canada revised their pictorial HWLs in 2012, more than a decade after they were first introduced in 2001.²⁴ While these revisions included the addition of new health messages and pictorials to tobacco packages, select messages were also removed. This study is the first to directly examine the impact of the Canadian HWL revisions on adult smokers' awareness of the displayed health facts. Although research has shown that adding messages to warnings increases smokers' awareness of these facts,^{12 14 15 20 25} to our knowledge, no studies have directly explored the impact of removing health messages from cigarette packages. This study therefore tests if adding messages to HWLs increases awareness of these facts *and* if removing messages has the opposite effect.

METHODS

Study design

Data for this study were taken from the International Tobacco Control (ITC) Canada Survey, a nationally representative longitudinal cohort survey conducted nearly annually since 2002. ITC surveys are designed to evaluate the psychosocial and behavioural impact of key national-level tobacco control policies of the WHO FCTC. To date, ITC surveys have been conducted in 29 countries covering over two-thirds of the world's tobacco users.

The data analysed in this study were collected over nine survey waves conducted between 2002 and 2013–2014 (survey dates are shown in [table 1](#)). Although the change in awareness between Wave 8 (2010) and Wave 9 (2013–14) was of particular interest because these waves were conducted directly before and after the 2012 revisions, including all prerevision waves in analyses allowed for a thorough evaluation of the impact by accounting for the secular trends in awareness occurring prior to the revisions.

Participants and survey procedures

Survey participants included adult smokers aged 18 years and older. Smokers were defined as having smoked more than 100 cigarettes in their lifetime and smoke at least monthly. Participants lost to attrition were replaced by newly recruited smokers to maintain overall sample sizes of 1500–2000 per wave. Participants with at least two waves of data were included in the study.

Data for Waves 1–6 were collected using computer-assisted telephone interviews (CATI), following a random-digit dialling sampling design to ensure random selection of households (with

landlines) within strata defined by 14 geographical regions. Online web-based surveys were piloted in Wave 7 and made available for all participants in Waves 8 and 9. Participants who did not complete the online survey within a set timeframe were rerouted back into the telephone interview queue to complete the survey by CATI.²⁶

Measures

Demographic characteristics

Demographic measures were sex (male or female), age group (18–24, 25–39, 40–54 or 55+ years), income (low=less than \$30 000; moderate= \$30 000–\$59 999, high= \$60 000 or more; or not stated) and education (low=high school diploma or lower; moderate=technical, trade school, community college or some university; or high=completed university or postgraduate).

Smoking behaviour

Smoking behaviours were measured using smoking status (daily or non-daily) and the Heaviness of Smoking Index (HSI). The HSI is a measure of smoking dependence that combines ordinal measures of two variables: number of cigarettes per day and time to the first cigarette of the day (reverse scored). The sum of these variables generates a scale ranging from 0 to 6, with a higher number indicating a greater dependence on smoking.²⁷ Values 0 and 1 were coded as low HSI, values 2 and 3 were coded as moderate and values 4, 5 and 6 were coded as high due to low frequencies in some categories.²⁸

Awareness of smoking-related health facts

To select measures of awareness to include in the study, both sets of Canadian HWLs (prerevision and postrevision) were reviewed, as well as all awareness items included in waves 1–9. A measure was included if it was matched to the content of a HWL and was present in at least one prerevision and postrevision survey. Awareness of health facts was then examined according to whether messages were added to or removed from HWLs in 2012. A message that was continuously displayed on HWLs between 2002 and 2014 was also included in the analysis as a control measure. The smoking-related health messages included in this study are presented in [figure 1](#).

To measure awareness of each fact, participants were asked, 'based on what you know or believe, does smoking cause...': stroke, impotence, bladder cancer and blindness (responses were coded 0: 'no', 'don't know'; and 1: 'yes'). Smokers were also asked if they knew if cigarette smoke contains carbon monoxide (responses were coded 0: 'no', 'don't know'; and 1: 'yes') and if nicotine is the main substance in cigarettes that makes people smoke (causes addiction) (responses were coded 0: 'false'; and 1: 'true').

Statistical analysis

Analyses were conducted using SAS V.9.4. Two principal analytical approaches were used. First, generalised estimating equation (GEE) regression models were conducted to estimate adjusted percentages of smokers who were aware of each health fact per wave. GEE models account for within-subject correlation arising when outcomes are measured on the same participant more than once.²⁹ GEE models were estimated using a binomial distribution and the logit link function. Contrast estimates were conducted to produce comparisons between wave 8 (prerevision) and wave 9 (postrevision) percentages.

Second, segmented regression analyses (also based on GEE regression models) modelled the temporal trends in awareness








Message	Pictorial	ITC survey waves that included awareness measures
Messages ADDED to HWLs in 2012		
Smoking causes blindness		PRE: Waves 3-8 POST: Wave 9
Smoking causes bladder cancer		PRE: Wave 8 POST: Wave 9
Nicotine is the substance that causes addiction		PRE: Waves 6-8 POST: Wave 9
Messages REMOVED from HWLs in 2012		
Smoking causes impotence		PRE: Waves 1-8 POST: Wave 9
Cigarette smoke contains carbon monoxide		PRE: Waves 1-5, 8 POST: Wave 9
Message CONTINUOUSLY DISPLAYED on HWLs		
Smoking causes stroke (2001-2012)		PRE: Waves 1-8 POST: Wave 9
Smoking causes stroke (2012-present)		PRE: Waves 1-8 POST: Wave 9

Figure 1 Canadian HWL messages added, removed and continuously displayed for which the ITC Canada survey included awareness measures both pre-2012 and post-2012 revision. HWL, health warning label; ITC, International Tobacco Control.

prerevision and postrevision (for measures collected in more than two survey waves). Segmented regression analyses consist of dividing a linear trend into separate intervals at a specified

‘breakpoint’ (date of the 2012 revisions), and a line segment is fit to each interval. A statistically significant difference between the intervals (slopes) can be taken as evidence of a treatment

Table 2 Unweighted sample characteristics of adult smokers in Canada, Waves 1–9 (n=5863)

	Frequency (n)	%
Sex		
Male	2750	46.9
Female	3113	53.1
Age (years)		
18–24	683	11.7
25–39	1711	29.2
40–54	2152	36.7
55+	1317	22.4
Education		
Low	2802	47.8
Moderate	2140	36.5
High	903	15.4
Missing*	18	0.3
Income		
Low	1614	27.5
Moderate	2002	34.2
High	1720	29.3
Not stated	503	8.6
Missing*	24	0.4
Status		
Daily smoker	5456	93.1
Non-daily smoker	407	6.9
Heaviness of Smoking Index		
Low	1309	22.3
Moderate	2634	44.9
High	1852	31.6
Missing*	68	1.2
Retention rate (wave to wave)		
Wave 1	2214	–
Wave 2	2196	75.8
Wave 3	2108	71.2
Wave 4	2029	71.6
Wave 5	2022	70.4
Wave 6	2015	72.2
Wave 7	1846	75.7
Wave 8	1581	74.4
Wave 9	1592	71.8

*Missing values were not included in analyses but are listed in the descriptive statistics table to ensure accurate sample sizes.

effect. Segmented regression analyses are an important evaluation method that places the evaluation within the context of time trends.³⁰ These analyses account for the secular trend in the data and for the differing time intervals between waves, thereby producing more time-precise interpretations of impact. Because the time between survey waves varied, the median date of each wave was calculated and used to plot the temporal trends.

All regression models adjusted for sex, age group, income, education, smoking status, HSI, survey wave, survey mode (telephone or online) and time in sample (the number of prior survey waves a participant has previously participated in³¹). Missing values were excluded from the analyses (but shown in table 2 to ensure accurate sample sizes). Analyses were weighted to allow generalisation to the Canadian population of adult smokers. Further information on how weights were constructed for the ITC-4 Surveys can be found in Thompson *et al.*³²

RESULTS

The total number of participants included in the analysis was 5863. Table 2 presents the unweighted sample characteristics of adult smokers included in Waves 1–9 of the ITC Canada Survey. Participants were somewhat more likely to be women (53.1%). Almost half (47.8%) of participants had a high school education or less, whereas the distribution of participants in low-income, moderate-income and high-income categories was fairly equal (27.5%, 34.2% and 29.3% respectively). The majority (93.1%) were daily smokers. Wave-to-wave retention rates were high and ranged from 70.4% to 75.7%.

Table 3 displays the GEE model-derived adjusted percentages of awareness in smoking-related health messages with 95% CIs. Messages are categorised according to whether they were added, removed or continuously displayed (before and after) on Canadian cigarette HWLs after the revisions. Figure 2 shows the difference between the predicted rates of awareness based on time trends (line of best fit based on GEE model-derived adjusted percentages) and the actual observed percentage.

Impact of adding messages to HWLs on smokers' awareness of those health facts

Smoking causes blindness

The percentage of smokers who were aware that smoking causes blindness increased slightly from 11.7% in 2004 to 14.7% in 2010 ($p=0.04$). After adding this message to HWLs, awareness significantly increased to 36.7% in 2013 ($p<0.001$). After the revisions, smokers were 3.36 (95% CI 2.71 to 4.18) times as likely to be aware that smoking causes blindness compared with before.

Accordingly, the segmented regression analysis (which accounts for the time trends in awareness over six waves conducted from 2004 to 2010) showed a significant increase in awareness after the blindness message was added to cigarette packages (prerevision segment $\beta=0.048$, postrevision segment $\beta=0.719$; $p<0.001$ for the test of the differences in slopes).

Smoking causes bladder cancer

The percentage of smokers who were aware that smoking causes bladder cancer also increased significantly after this message was added to cigarette packages—from 26.8% in 2010 to 44.0% in 2013 (OR=2.14 (95% CI 1.71 to 2.66), $p<0.001$). Segmented regression analyses were not possible for this measure because knowledge about bladder cancer was only measured in one wave prior to the introduction of this message.

Nicotine causes addiction

There were no significant changes in awareness that nicotine is the substance that causes addiction before or after the 2012 revisions: rates of awareness increased slightly from 90.1% in 2007 to 90.5% in 2010 ($p=0.76$), and then decreased to 89.6% in 2013 ($p=0.55$). The segmented regression analysis showed that there was no significant change in the trend after the revisions (prerevision segment $\beta=0.011$, postrevision segment $\beta=-0.063$; $p=0.74$ for the test of the differences in slopes).

Impact of removing messages from HWLs on smokers' awareness of those health facts

Smoking causes impotence

The percentage of smokers who were aware that smoking causes impotence increased from 60.7% in 2002 to 67.8% in 2010 ($p=0.004$) during the time when this message was displayed on cigarette packages. Following the removal of the impotence

Table 3 GEE model adjusted percentages in awareness of smoking-related health messages among Canadian smokers, 2002–2013

Median survey date (wave #)	Added in 2012			Removed in 2012		Continuously displayed
	Smoking causes blindness (%)	Smoking causes bladder cancer (%)	Nicotine causes addiction (%)	Smoking causes impotence (%)	Cigarette smoke contains carbon monoxide (%)	Smoking causes stroke (%)
November 2002 (Wave 1)	N/A	N/A	N/A	60.7 (57.8–63.5)	90.9 (89.1–92.4)	84.6 (82.4–86.6)
June 2003 (Wave 2)	N/A	N/A	N/A	59.7 (56.8–62.4)	90.8 (89.1–92.2)	84.3 (82.0–86.3)
July 2004 (Wave 3)	11.7 (10.0–13.5)	N/A	N/A	61.3 (58.6–62.4)	92.8 (91.3–94.0)	86.6 (84.6–88.3)
November 2005 (Wave 4)	15.1 (13.2–17.2)	N/A	N/A	63.5 (61.0–66.0)	90.3 (88.6–91.7)	87.1 (85.2–88.8)
November 2006 (Wave 5)	16.0 (14.1–18.1)	N/A	N/A	65.7 (63.2–68.2)	91.2 (89.4–92.6)	86.9 (85.0–88.6)
December 2007 (Wave 6)	18.5 (16.4–20.8)	N/A	90.1 (88.2–91.7)	67.5 (65.0–69.9)	N/A	87.6 (85.6–89.3)
January 2009 (Wave 7)	15.9 (13.9–18.1)	N/A	89.0 (86.9–90.8)	66.2 (63.3–68.9)	N/A	87.3 (85.2–89.1)
August 2010 (Wave 8)	14.7 (12.5–17.1)	26.8 (23.7–30.1)	90.6 (88.2–92.5)	67.8 (64.3–71.1)	92.4 (90.1–94.2)	87.5 (84.7–89.8)
May 2012	Revision of warning labels					
October 2013 (Wave 9)	36.7*† (32.6–40.9)	44.0* (40.4–47.5)	89.6 (86.9–91.8)	66.2† (62.3–69.9)	86.7*† (83.7–89.2)	88.7 (86.1–90.8)

Percentages are weighted.

*Significant difference ($p < 0.05$) from 2010 to 2013 (GEE contrast of the means).

†Significant difference ($p < 0.05$) in slopes before and after 2012 HWL revisions (segmented regression analysis).

GEE, generalised estimating equation; HWL, health warning label.

message in 2012, awareness fell slightly to 66.2%, but this decrease was not statistically significant ($p = 0.42$). However, the segmented regression analysis showed that the trend in awareness (which was slightly positive) significantly changed in a negative direction (prerevision segment $\beta = 0.050$, postrevision segment $\beta = -0.149$; $p = 0.007$ for the test of the differences in slopes).

Cigarette smoke contains carbon monoxide

The percentage of smokers who were aware that cigarette smoke contains carbon monoxide remained stable at approximately 91%–92% between 2002 and 2010 ($p = 0.28$), the time period when this message was displayed on HWLs. Following the removal of this message in 2012, awareness significantly decreased from 92.4% in 2010 to 86.7% in 2013 (OR = 0.53 (95% CI 0.41 to 0.70), $p < 0.001$). The segmented regression analysis also showed a significant decrease in awareness after the message was removed in 2012 (prerevision segment $\beta = 0.014$, postrevision segment $\beta = -0.446$; $p < 0.001$ for the test of the differences in slopes).

Awareness of health messages continuously displayed on HWLs

Smoking causes stroke

The message that smoking causes stroke appeared on cigarette packages both before and after the 2012 revisions. The percentage of smokers who were aware that smoking causes stroke increased from 84.6% in 2002 to 88.7% in 2013 ($p = 0.02$), but there was no significant change in awareness between 2010 and 2013 ($p = 0.35$). Accordingly, the segmented regression analysis showed no statistically significant changes in the trend in awareness after the revisions (prerevision segment $\beta = 0.037$, postrevision segment $\beta = 0.003$; $p = 0.73$ for the test of the differences in slopes).

Estimating population impact of adding and removing health messages from HWLs

ITC Canada Survey is a nationally representative sample of Canadian smokers, allowing for estimation of the population impact of adding and removing health message from HWLs in terms of the number of smokers in Canada affected by these revisions. The percentage differences between the observed percentage of awareness and the estimated percentage from the prerevision linear trend for the two *added* facts were: (1) for bladder cancer: 36.7% observed – 18.2% linear estimate = +18.5%; and (2) for blindness: 44.0%–26.8% (wave 8 only; no prior data) = 17.2%. Multiplying these differences by the number of Canadian smokers in 2012 of 5.9 million³³ produces estimates that an additional 1.09 million smokers were aware that smoking causes bladder cancer and an additional 1.01 million smokers were aware that smoking causes blindness after these message were added to HWLs.

Using the same method for the two *removed* facts, the percentage differences were: (1) for impotence: 66.2% observed – 72.2% linear estimate = –6.0%; and (2) for carbon monoxide: 86.7% observed – 92.5% linear estimate = –5.8%, yielding estimates that 354 000 fewer smokers were aware that smoking causes impotence and 342 000 fewer smokers were aware that cigarette smoke contains carbon monoxide after these messages were removed from HWLs.

DISCUSSION

This is the first longitudinal study to directly investigate the impact of adding *and* removing messages from cigarette packages on smokers' awareness about the health harms of smoking. The results showed that smokers' awareness that smoking causing bladder cancer and blindness both increased significantly after these messages were added to the Canadian warnings in 2012, with an additional 1.09 million smokers being aware that

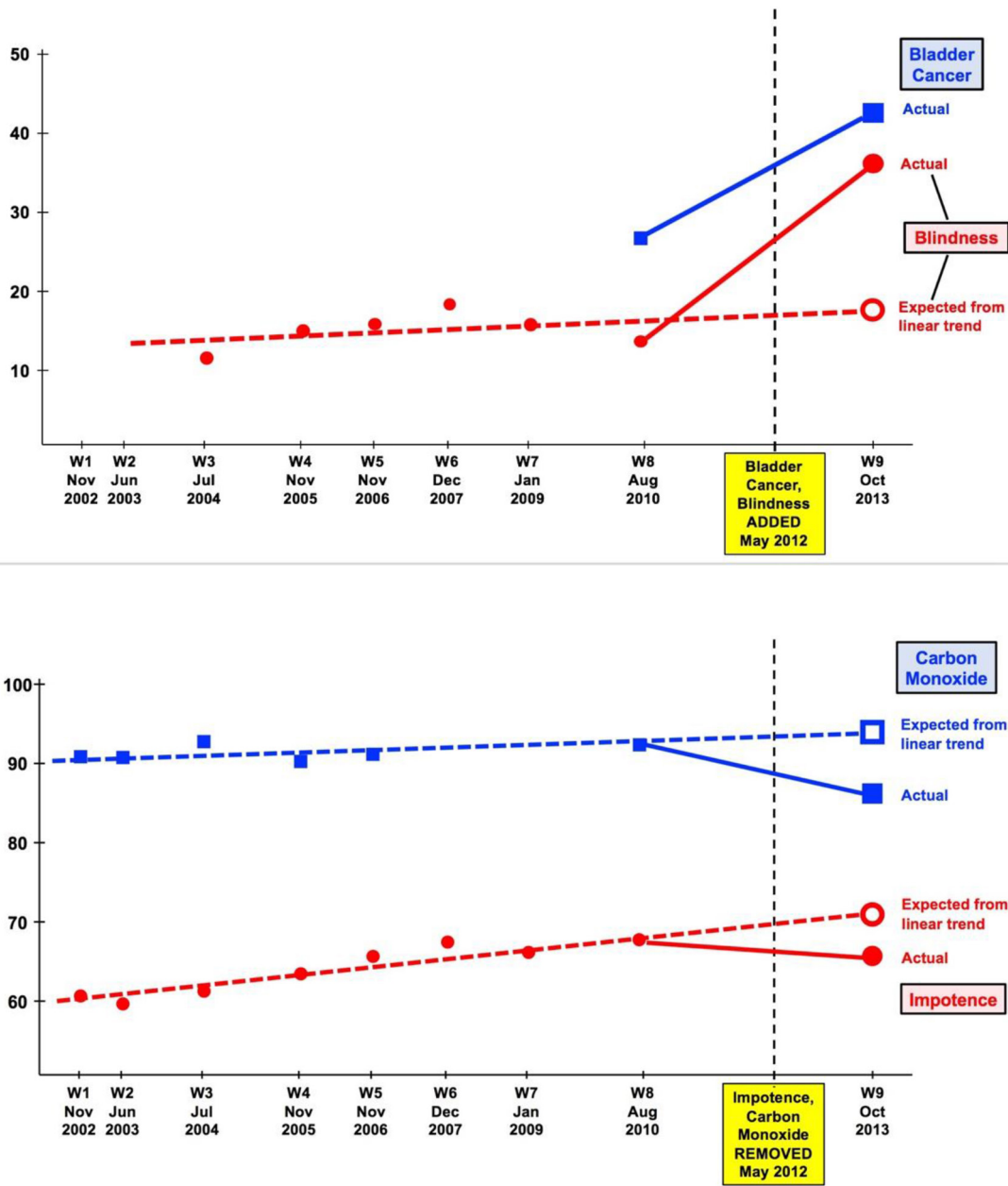


Figure 2 The predicted trends and actual rates of awareness of smoking-related messages added to and removed from Canadian HWLs in 2012, based on GEE model adjusted percentages. GEE, generalised estimating equation; HWLs, health warning labels.

smoking causes blindness and an additional 1.01 million smokers being aware that smoking causes bladder cancer.

Although the message stating that nicotine causes addiction was also added to the warnings in 2012, there was no significant change in awareness. In fact, awareness that nicotine causes addiction remained stable between 2007 and 2013, ranging between 89.0% and 90.6%. A likely explanation for this finding is that a very similar message was displayed before the revision: ‘Cigarettes are highly addictive’. Therefore, though not explicitly attributing addiction to nicotine, this detail may be common knowledge among smokers (and the greatest impact of novel warnings is at the time of or directly after implementation¹⁶).

Importantly, this study is the first to examine the impact of removing messages from HWLs, and the results showed that doing so led to reductions in awareness of those health facts. Awareness that cigarette smoke contains carbon monoxide

significantly decreased after the message was removed from HWLs, with 342 000 fewer Canadian smokers being aware of this health fact. Although the GEE analysis found that rates of awareness that smoking causes impotence did not decrease after the removal of this message, the segmented regression analysis, which takes into account the temporal trend in awareness before the revision, showed that there was a significant decrease in the percentage of smokers who were aware of this fact—equivalent to 354 000 fewer smokers. These findings therefore demonstrate that HWLs are an important source of health information for smokers and that removing messages from HWLs decreases awareness, potentially reversing the benefits of adding health messages to awareness.

The findings of this study have important implications. Given that most smokers tend to underestimate the consequences of smoking, it is crucial that governments implement pictorial HWLs

to better communicate the health harms of smoking.^{14 34} It is also vital that policy makers ensure the timely and frequent rotation of health messages on tobacco packages (as recommended by the FCTC), particularly as research continues to uncover the increasingly numerous health harms of tobacco smoke.² A wider range of messages displayed on HWLs is likely to have a greater impact on smokers' awareness of health harms, especially those that are less known, as the results of this study have shown. This is important because increased health knowledge is an important goal in and of itself and increased smoking-related knowledge can influence cessation-related behaviour.⁷⁻¹² For example, increased knowledge about the harms of smoking has been shown to be associated with increased health concerns, which increases quit intentions and quit attempts.^{9 35 36}

Importantly, this study showed that the overall positive impact of adding messages to HWLs on smokers' awareness of those facts was greater than the overall negative impact of removing them. This is reasonable given that the two messages added—smoking causes bladder cancer and blindness—were not generally known prior to their inclusion (27% and 15%, respectively), and thus their display on HWLs was more likely to have a greater impact on awareness compared with the impact of removing two messages—cigarette smoke contains carbon monoxide and smoking causes impotence—that were likely to remain known due to the high awareness levels (92% and 68%, respectively) acquired during their previous and lengthy display. This demonstrates that policy makers need to achieve a balance between the benefits of adding new information and the costs of removing even widely known messages from HWLs. Achieving this balance may differ across countries and may depend on the severity, prevalence and novelty of the various messages that are being considered for inclusion on HWLs.

There are a few limitations of this study. Assessing participants' levels of knowledge was based on yes/no questioning of a predetermined set of health conditions. It is possible that lower levels of awareness may have been observed if participants were asked to list smoking-related diseases unprompted (with open-ended questions). However, even if true rates of awareness were lower than those reported in this study, it is likely that the nature of the trend would be the same. This is expected because survey measurements were consistent over time, so even if slightly biased, the trend would still be detectable. Furthermore, a similar trend of increased awareness was found in previous research using unprompted message recall to measure smoking-related knowledge in Australia following the introduction of new content on Australian HWLs.¹⁵

The restriction of the sample to landline telephones from Waves 1–7 is another potential limitation. However, this is unlikely to have significantly impacted the results as research conducted by the Government of Canada has shown that a very high proportion of Canadians used landline telephones throughout the years of this study.³⁷

Finally, a potential limitation is the non-randomised nature of this study, which can limit inferences of a causal relationship. For example, it could be possible that the difference in magnitude of impact between adding and removing warnings was influenced by warning presentation (eg, image style). This is unlikely to have occurred, however, as made evident by the fact that a highly graphic warning (the prerevision stroke warning) was replaced by a warning that conveyed the same message but with a far 'milder' image, and rates of awareness of this fact were not significantly impacted (deviating by less than a per cent). Additionally, the use of a naturalistic observational design is a strength of this study as it allows for the examination of genuine

behaviours without the impact of forced experimental conditions, thus increasing its external (ecological) validity.³⁸

CONCLUSIONS

The current study demonstrates that adding health messages to cigarette packages increased smokers' awareness of these facts and that removing messages from warnings decreased smokers' awareness of that information. The results emphasise that policy makers and public health officials must take careful consideration when deciding which messages should appear on HWLs in order to maximise the benefits of this key policy.

What this paper adds

- ▶ Health warning labels on cigarette packages are an effective communication strategy to raise awareness of the health harms of smoking.
- ▶ Although research has shown that adding health messages to warnings increases smokers' awareness of this information, this study is the first to directly examine if removing health messages from cigarette packages also decreases awareness.
- ▶ This study showed that adding health messages to warnings increased smokers' awareness of displayed facts and that removing messages from warnings decreased smokers' awareness.
- ▶ These findings demonstrate the importance of carefully considering the implications of adding and especially removing health facts in health warnings, and also the importance of revising health warnings frequently, as called for by the Article 11 Guidelines of the Framework Convention on Tobacco Control.

Contributors ACG led in designing the study and writing the manuscript. ACG and PD conducted the statistical analyses. GTF, PD, SMN and DH contributed to the revision of the draft. The final version of this paper was reviewed and approved by all coauthors.

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Competing interests DH has served as an expert witness in legal challenges against tobacco companies. DH and GTF have served as expert witnesses on behalf of governments in litigation involving the tobacco industry.

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Data sharing statement All data relevant to the study are included in the article or uploaded as supplementary information.

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