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Research

Impact of Canadian tobacco packaging policy on use of a toll-free quit-smoking line: an interrupted time-series analysis

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Abstract

Background: A policy for new pictorial health warning labels on tobacco packaging was introduced by Health Canada in 2012. The labels included, for the first time, a prominently displayed toll-free number for a quit-smoking line. We used data from the Ontario provincial quitline to investigate the call volume and number of new callers receiving treatment in the months before and after the new policy was introduced.

Methods: We used an interrupted time-series analysis to examine trends in the overall call volume and number of new callers receiving treatment (≥ 1 telephone counselling session) through Ontario's quitline (Smokers' Helpline) between January 2010 and December 2013. We analyzed data using Box–Jenkins autoregressive integrated moving-average models; we adjusted the models for a major campaign promoting the quitline, a seasonality (January) effect and tobacco pricing.

Results: We found a relative increase of 160% in the average monthly call volume during the 7 months after the introduction of the new labels (870 calls per month at baseline and 1391 additional calls per month on average after the policy change; standard error [SE] 108.94, $p < 0.001$), and a sustained increase of 43% in subsequent months. We observed a relative increase of 174% in the number of new callers receiving treatment (153 new callers per month at baseline and 267 additional new callers per month after the policy change; SE 40.03, $p < 0.001$) and a sustained increase of 80% in subsequent months. The effect was significant even after controlling for a major promotion campaign and the January effect.

Interpretation: We found a significant increase in the monthly overall call volume and number of new callers receiving treatment per month after the introduction of the new tobacco health warning labels, with a sustained increase in overall calls and new callers beyond the first 7 months. Our findings add to the body of evidence on the benefit of including a toll-free quitline number on tobacco packaging.

Tobacco is a leading cause of preventable illness and death in Canada and throughout the world.[1,2] About 100 Canadians are estimated to die each day from a smoking-related illness.[3] The economic impact of tobacco-related illness in Canada is also substantial, with the annual burden of tobacco smoking estimated to be $21.3 billion.[4] In Ontario, Canada's largest province, smoking is the biggest factor contributing to hospital bed use, accounting for 22% of men's and 12% of women's hospital bed-days and almost $1 billion in hospital costs in 2011.[5] In 2013, the prevalence of smoking in Ontario was 12.6%, below the national average of 14.6% among Canadians aged 15 years and older.[6]

Canada introduced pictorial health warning labels on cigarette packages in 2000. A new set of pictorial health warning labels were introduced by Health Canada in 2012 (Figure 1). These labels included, for the first time, a pan-Canadian toll-free number for a quit-smoking helpline (quitline) that, once called, automatically sends the caller to the quitline service of their respective province or territory.[7] As of Mar. 21, 2012, manufacturers are prohibited from producing cigarette packages without the new health warning labels, and as of June 18, 2012, retailers are prohibited from selling cigarettes without the labels. Including a toll-free quitline number in warning labels on cigarette packages has been found to increase call volume and number of registrants.[8,9] For example, following the introduction of graphic warning labels with a quitline number in Australia, the number of calls to the quitline increased by 84%.[10]

Competing interests: Bruce Baskerville, Nghia Nguyen, Lynda Hayward, Ryan David Kennedy and Sharon Campbell were employed at the Propel Centre for Population Health Impact at the time of the study. The centre has received contracts from the Ontario government for data monitoring and evaluation reports for its Smokers' Helpline; it did not have a contract at the time of the study. No other competing interests were declared.

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Quitlines are an effective public health intervention that can be used by smokers who are motivated to seek support to quit using tobacco.[11] Their use is supported in a US Department of Health Human Services clinical practice guideline on treating tobacco use and dependence.[12] Quitlines can be easily accessed free of charge, have no eligibility restrictions and provide evidence-based information, advice and motivational counselling to callers.[13] The volume of calls has frequently been used as an indicator of interest in quitting in response to population-based smoking cessation policies, such as health warning labels with a toll-free quitline number.[10,14,15]

We used data from the Ontario provincial quitline to investigate whether there were changes in call volumes, the number of new callers receiving treatment and the characteristics of new callers in the months leading up to, and after, the introduction of Health Canada's new policy of having health warning labels include the toll-free quitline number. Implementation of the new policy and inclusion of the pan-Canadian quitline number on tobacco packaging is an example of a natural experiment (i.e., a rapidly unfolding policy that is not under the control of the investigation team).[16]

Methods

Study design

We used an interrupted time-series analysis[16,17] to identify patterns over time in the sequence of use of Ontario's quitline (Smokers' Helpline) in terms of overall monthly call volume and number of new callers receiving treatment. Treatment was defined as receiving at least 1 telephone counselling session, because individuals who receive treatment have an increased probability of quitting.[11] We chose an interrupted time-series design, with adjustment for secular trends, because it is an ideal design for assessing the effects of a population-wide intervention such as a toll-free quitline number on tobacco packaging.[16,17] Because the new health warning labels were on cigarette packages as of Mar. 21, 2012, we considered March 2012 as the start of the intervention and looked at the call volume and number of new callers receiving treatment before and after this date, while adjusting for a major campaign promoting the quitline, a seasonality effect and tobacco pricing.

We used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline statement[18] to assist in the reporting of the study.

The study design was approved by the Office of Research Ethics at the University of Waterloo.

Outcome measures

Monthly overall call volume and number of new callers receiving treatment were the 2 variables we used to determine the impact of the new health warning labels on use of the Smokers' Helpline. Data on call volume (both calls handled and calls abandoned) and new callers were collected for 48 months between January 2010 and December 2013 from the Smokers' Helpline telephone switchboard and intake database, respectively. New callers receiving treatment were defined as people who initiated contact by calling the quitline, were 18 years of age or older, smoked daily or occasionally at the time of the first call (or had quit within the past 30 days), received treatment from the Smokers' Helpline (≥ 1 telephone counselling session) and had no contact with the quitline in the 12 months before calling.[19] Tracking the number of new callers over time allows for a better determination of the impact of the new health warning labels on encouraging callers to use the promoted quitline. Age, sex, education, ethnicity, smoking status (daily or occasional), cigarette consumption, quit intentions and the Heaviness of Smoking Index scores were collected at intake for new callers.[20,21]

We conducted an environmental scan of Ontario quitline promotion campaigns during the study period and identified the Driven to Quit Challenge as the only province-wide campaign that promoted the quitline. The Driven to Quit Challenge was a media campaign run in February that promotes Smokers' Helpline through a contest offering smokers a chance

Figure 1: Example of a health warning label for Canadian tobacco packaging introduced in March 2012. Additional examples can be found on Health Canada's website (at www.hc-sc.gc.ca/hc-ps/tobac-tabac/legislation/label-etiquette/cigarette-eng.php).

to win prizes if they quit. The campaign was run in February 2010, 2011 and 2012, but not in 2013.

Other variables that could increase the volume of calls to the quitline included the January effect and tobacco pricing. The January effect is a seasonal phenomenon where people decide to make lifestyle changes such as stopping smoking as a New Year's resolution, which results in increased calls to Smokers' Helpline.[22,23] The January effect in 2010, 2011 and 2012 occurred before the policy change in health warning labels, and the January 2013 effect occurred after the policy change. For tobacco pricing, we included Ontario tobacco prices for 200-cigarette cartons to adjust for the effect of price on desire to quit smoking.[24] Cigarette prices starting in 2010 were provided by the Non-Smokers' Rights Association, and we adjusted for inflation (2002 = 100) for each month using the Consumer Price Index provided by Statistics Canada.[25]

Statistical analysis

We summarized caller characteristics before and after the policy change in health warning labels using means and standard deviations for continuous variables and compared them using the *t* test for independent groups. We summarized categorical variables with frequency percentages and compared them using a χ^2 test. Monthly call volumes and new caller data were plotted on a graph over the 48-month study period. For descriptive purposes, we calculated means, 95% confidence intervals (CIs) and percent change in monthly call volume and number of new callers before and after the new policy, with and without data for February in the years the Driven to Quit Challenge was held, and with and without data for January to account for the January effect.

To identify whether changes over time in the monthly call volume and number of new callers were related to the new health warning labels, we used the Box–Jenkins autoregressive integrated moving average model (ARIMA[*p*,*d*,*q*]), where *p* is the number of autoregressive terms, *d* is the number of nonseasonal differences needed for stationarity, and *q* is the number of lagged forecast errors in the prediction equation.[26] The ARIMA model was preferable to traditional regression techniques because it takes into account whether subsequent values were correlated; such autocorrelation violates the assumption of independence central to linear regression. There were 3 years in which the Driven to Quit Challenge occurred before the policy change to the new health warning labels and none after the policy change. Similarly, the January effect was present in 3 of the 26 months before the policy change but in only 1 of the 22 months after the new policy was introduced. Therefore, it was important to adjust for the promotion campaign and the January effect when comparing outcomes in the pre- and postintervention periods.

We investigated a number of possible models using autocorrelation and partial autocorrelation functions and checked the stationarity properties of the residuals from models for both the overall call volume and new caller time series to identify statistically adequate and parsimonious models. We assessed the adequacy of candidate models by examining the autocorrelation function and partial autocorrelation function plots of residuals, Ljung–Box χ^2 tests for normally distributed white noise residuals and Q–Q plots of residuals. When necessary, we used the Akaike information criterion to compare 2 nested candidate models. The ARIMA(1,0,0) models provided adequate fits for both the overall call volume and the new caller time-series data subsets. We compared the fit from the predicted model and the observed series using the adjusted R^2 measure and the root-mean-square error for ease of interpretation.

To obtain an understanding of the impact of the new health warning labels over the long term, we investigated 2 ARIMA models (for overall call volume and for number of new callers receiving treatment) covering the 48-month study period (26 months before and 22 months after the policy change). The 2 models included binary dummy variables to model the effect of the new labels (coded as 1 for March 2012 to December 2013, and 0 otherwise), the sustainability of the effect (coded as 1 for October 2012 to December 2013, and 0 otherwise), the seasonal January effect to account for the increase in number of calls in the new year, and the Driven to Quit Challenge in February 2010, 2011 and 2012, as well as Ontario tobacco prices as a continuous variable. We coded for the sustainability effect to account for the decline in call volume and number of new callers after September 2012, as found in other quitline studies.[10,27] The effects of the potential confounders of the Driven to Quit Challenge and the January effect were significant and so were retained in the final model; tobacco pricing was discarded because it was not statistically significant.

Analyses for the study were conducted using SPSS version 22.0 (IBM Corporation).

Results

The characteristics of new callers receiving treatment changed significantly after the introduction of the new health warning labels in March 2012 (Table 1). For example, after the policy change, new callers were more likely to be male, to have a high school education or less, to be younger, to be daily smokers at intake (v. occasional smokers), to have an intention of quitting within 30 days and to have a reported ethnicity other than white.

Figure 2 shows the changes over time in the monthly overall call volume and number of new callers receiving treatment during the study period. The call volume and number of new callers were noticeably higher during the first 7 months after introduction of the new health warning labels (March to September 2012); the call volume peaked in the fourth month (June 2012), and the number of new callers peaked in the third month (May 2012). Table 2 shows the mean changes in call volume and number of new callers before and after the policy change, as well as the influence of the Driven to Quit Challenge and the January effect. After the policy change, the call volume increased by 52.5%, to a mean of 1591 (95% CI 1355–1827) calls per month, as compared with a mean of 1043 (95% CI 868–1218) calls per month before March 2012 (Table 2). Similarly, the number of new callers receiving treatment increased by 80.5%, from a monthly average of 185 (95% CI 146–224) before the new policy to an average of 334

Table 1: Characteristics of new callers to Smokers' Helpline in Ontario before and after Health Canada's new policy for health warning labels on tobacco packaging, January 2010–December 2013

Characteristic*	Period; no. (%) of new callers†			*p* value
	Total	Before new policy	After new policy	
All new callers	*n* = 12 157	*n* = 4815	*n* = 7342	
Age, yr, mean ± SD	45.6 ± 14.9	47.0 ± 14.1	44.6 ± 15.3	< 0.001
Sex, male	5709 (47.0)	1966 (40.8)	3743 (51.0)	< 0.001
Education, high school or less	4160 (46.1)	1384 (37.7)	2766 (51.9)	< 0.001
Ethnicity, white	6730 (81.7)	2400 (85.7)	4330 (79.6)	< 0.001
Smoking status at time of call				< 0.001
Daily	10 115 (83.2)	3692 (76.7)	6423 (87.5)	
Occasional	133 (1.1)	47 (1.0)	86 (1.2)	
Recently quit	1909 (15.7)	1076 (22.4)	833 (11.4)	
Smokers (daily or occasional)	*n* = 10 248	*n* = 3739	*n* = 6509	
Cigarette consumption per day				0.8
1–10	2904 (24.5)	1151 (24.9)	1753 (24.3)	
11–20	3967 (33.5)	1546 (33.4)	2421 (33.5)	
21–30	3420 (28.9)	1335 (28.9)	2085 (28.9)	
≥ 31	1563 (13.2)	595 (12.9)	968 (13.4)	
Time to first cigarette in morning, min				0.04
≥ 61	1118 (11.8)	391 (11.1)	727 (12.3)	
31–60	884 (9.4)	327 (9.3)	557 (9.4)	
6–30	2856 (30.2)	1025 (29.2)	1831 (30.9)	
< 5	4592 (48.6)	1773 (50.4)	2819 (47.5)	
Heaviness of Smoking Index				0.2
Low	2518 (26.7)	913 (26.0)	1605 (27.1)	
Medium	4028 (42.7)	1544 (44.0)	2484 (42.0)	
High	2886 (30.6)	1053 (30.0)	1833 (31.0)	
Intention to quit in 30 d	9199 (90.4)	3276 (88.6)	5923 (91.3)	< 0.001

*Missing data for age (*n* = 824), sex (*n* = 6), education (*n* = 3134), ethnicity (*n* = 3915), cigarette consumption (*n* = 303), time to first cigarette in the morning (*n* = 798), Heaviness of Smoking Index (*n* = 816) and intention to quit in 30 d (*n* = 67).
†Unless stated otherwise.

(95% CI 288–380) afterward. It is important to note that the differences between the pre- and postintervention periods are affected by the imbalance in the number of months with the Driven to Quit Challenge and the relative number of months of the January effect, as described in Methods.

Table 3 provides the ARIMA model estimates, and Figure 2 includes the fitted model values for overall call volume and number of new callers, with adjustment for the Driven to Quit Challenge and the January effect as confounders. For the overall call volume data, the autoregressive parameter was not significant ($p = 0.3$). However, we retained it in the model for comparability with the model for the number of new callers. For the monthly overall call volume, the baseline level (the mean volume adjusted for the Driven to Quit Challenge and the January effect) was 870 calls per month before the policy change. The volume increased significantly by 1391 additional calls (total 2261) per month on average from March to September 2012, for a relative increase of 160%. In subsequent months (October 2012 to December 2013), there were 1019 fewer calls per month on average than during the first 7 months; however, the average number of calls was still 43% higher than at baseline.

For the number of new callers receiving treatment, the autoregressive parameter was significant ($p = 0.007$). The baseline number was 153 new callers per month before the policy change; the number increased significantly by 267 additional calls (total 420) per month on average from March to September 2012, for a relative increase of 174%. The effect was sustained in subsequent months: although there were 145 fewer new callers per month on average than during the first 7 months after the policy change, an estimated 80% of new callers per month were retained. Both the Driven to Quit Challenge and the January effect were significantly associated with call volumes and number of new callers. The analysis showed that the effect of the policy change on both

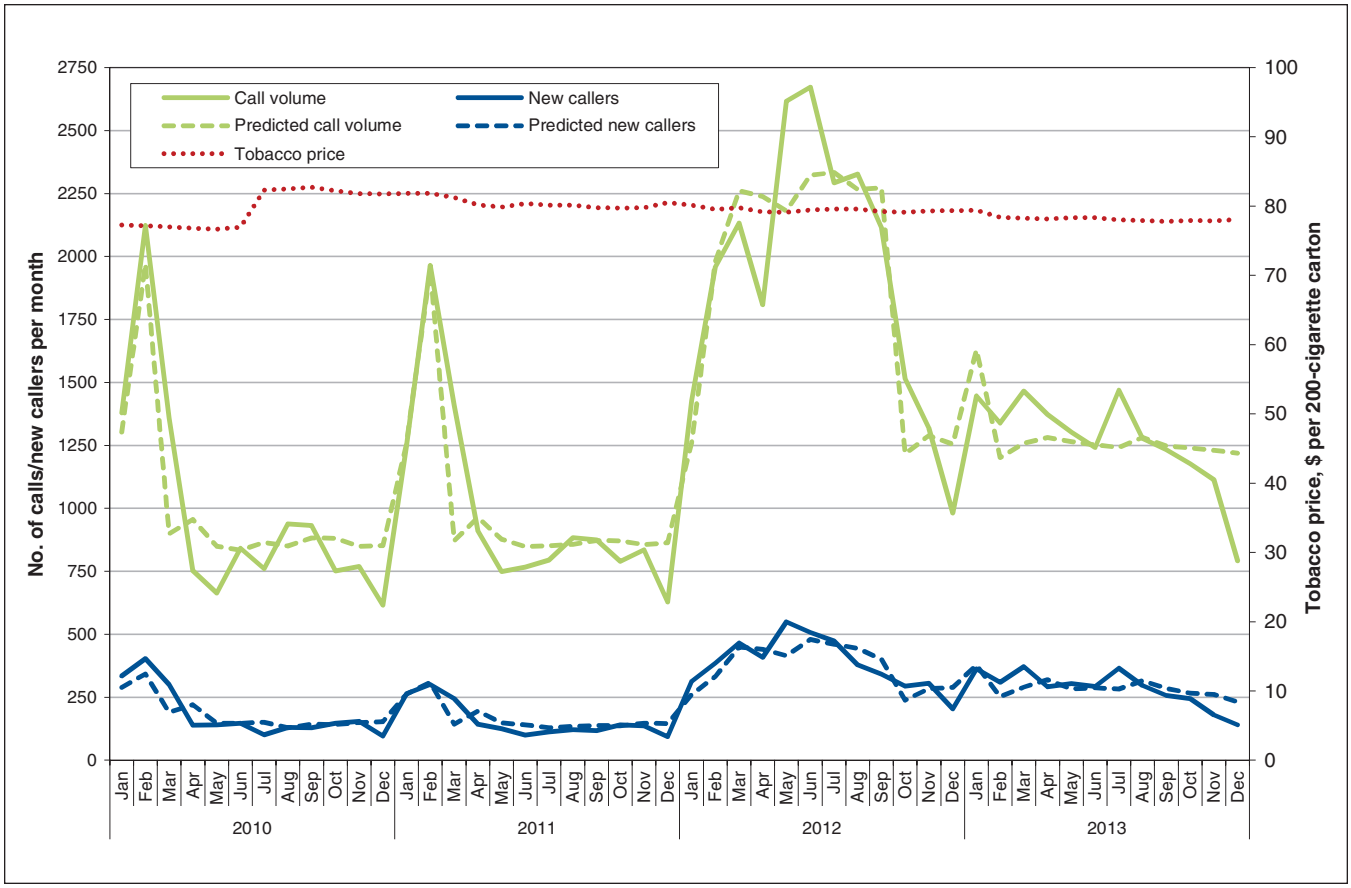

Figure 2: Actual and predicted monthly call volume and number of new callers receiving treatment (≥ 1 telephone counselling session) in Ontario before and after the introduction of new health warning labels in March 2012.

Table 2: Changes in overall call volume and number of new callers per month before and after new policy for health warning labels, and with and without effect of promotion campaign and January effect*

Variable	Overall call volume, mean (95% CI)†	No. of new callers, mean (95% CI)†
New policy for health warning labels‡		
Before policy	1043 (868–1218)	185 (146–224)
After policy	1591 (1355–1827)	334 (288–380)
Difference, %	52.5	80.5
Promotion campaign (Driven to Quit Challenge)§		
During months without campaign	1246 (1086–1407)	246 (209–283)
During months with campaign	2016 (1783–2248)	363 (226–500)
Difference, %	61.8	47.5
January effect		
During months excluding January	1287 (1113–1461)	247 (209–286)
During months including January	1376 (1234–1518)	318 (252–384)
Difference, %	6.9	28.7

Note: CI = confidence interval.
*Seasonal phenomenon where people decide to make lifestyle changes such as stopping smoking as a New Year's resolution.
†Unless stated otherwise.
‡Unadjusted for the effects of promotion campaign and January effect.
§Driven to Quit Challenge campaign was held in February 2010, 2011 and 2012, but not in February 2013.

Table 3: Autoregressive integrated moving average (ARIMA) results for monthly overall call volume and number of new callers receiving treatment over 48 months

	Monthly call volume		New callers per month	
Parameter	Estimate (SE)	*p* value	Estimate (SE)	*p* value
Intervention				
Baseline*	869.79 (55.40)	< 0.001	152.81 (20.68)	< 0.001
New policy for health warning labels† (March 2012–December 2013)	1390.62 (108.94)	< 0.001	267.02 (40.03)	< 0.001
Sustainability‡ (October 2012–December 2013)	−1018.99 (113.54)	< 0.001	−145.04 (40.64)	0.001
Other events				
Driven to Quit Challenge§	1087.37 (130.43)	< 0.001	168.36 (32.88)	< 0.001
January effect¶	433.17 (117.35)	0.001	135.80 (29.22)	< 0.001
Autoregressive parameter	0.175 (0.169)	0.3	0.460 (0.163)	0.007
Model diagnostics				
Stationary R^2	0.87		0.82	
Root-mean-square error	212.25		55.36	

Note: SE = standard error.
*Constant in model (the average monthly call volume and new callers per month, adjusted for months with no intervention and no Driven to Quit Challenge or January effect).
†Additional average monthly call volume and new callers per month over baseline for March 2012–December 2013.
‡Average monthly reduction in call volume and new callers per month from peak months of March 2012–September 2012.
§Equal to 1 for months during which promotion campaign occurred (February 2010, 2011 and 2012) and 0 otherwise.
¶Equal to 1 in January and 0 otherwise.

the overall call volume and the number of new callers receiving treatment was stable and sustained after adjustment for the promotion campaign and January effect.

Interpretation

We found a significant increase in both the monthly overall call volume to Smokers' Helpline in Ontario and the number of new callers receiving treatment per month after the introduction of the new health warning labels on Canadian tobacco packaging, even after we controlled for a major promotion campaign and the January effect. The call volume and number of new callers peaked in the fourth and third month, respectively, after the new policy was introduced; the effect lasted for 7 months and was sustained for an additional 15 months.

Our findings add to the body of evidence of the benefit of including a toll-free quitline number on tobacco packages.[9,10,14,27,28] We found a sustained increase of 43% and 80% in the monthly call volume and number of new callers, respectively, that was attributable to the new health warning labels having a toll-free quitline number. A similar experience has been reported in other countries.[10,27] In Australia, when new plain packaging and health warnings with a prominently displayed quitline number were introduced, the number of calls to the quitline increased by 78%.[10] A study by Bot and colleagues showed a mean relative increase of 100% 1 year after the introduction of health warning labels across 7 European countries.[27] Similar to the study in Australia,[10] Bot and colleagues found the January effect to be significant and did not find cigarette prices to be a significant factor related to use of the quitline. However, Ontario tobacco taxes did not increase during our study period after the rise in tobacco pricing on July 1, 2010, due to implementation of the 8% provincial portion of the harmonized sales tax. Furthermore, Canada's new policy for health warning labels has shown increased population-level awareness of the toll-free quitline and of the quitline services in terms of both overall reach and reach equity into subgroups of smokers who bear an undue burden from tobacco.[29] The new policy has reduced inequity: characteristics of callers to Ontario's quitline changed significantly after the policy change, with a higher proportion of callers being younger, male and nonwhite and having a lower educational level.

Strengths and limitations

Strengths of the study include accounting for other known influences on the use of the quitline, such as promotion campaigns. In addition, our study has introduced the indicator number of new callers, which other studies to date have not used. We believe that this indicator better reflects the impact of a policy change such as new health warning labels showing a toll-free quitline number, because one would expect to see calls from smokers not familiar with quitline services to increase. Call volumes and number of new callers are direct behavioural indicators of quitting intentions and are not subject to the social desirability and measurement biases that may occur in self-report surveys. Furthermore, quitline data allow for assessment of the impact of the new health warning labels in real time and are ideal for interrupted time-series analysis as a robust method for the evaluation of a policy that affects the whole population and where randomization or a control group is impossible.[30]

Our study's limitations are those typical of studies that use administrative data.[31] The quitline data were cleaned, coded and checked for consistency to ensure quality; however, some errors in reporting may have existed. Despite these limitations, the data represent all caller activity for the province of Ontario over a 4-year period, and thus we believe our findings are significantly robust to provide an understanding of the association between the new health warning labels and increased use of the quitline in Ontario. Although the time-series study design cannot prove causation, we have shown a positive and sustained association between a policy intervention and smoker response.

Conclusion

The addition of a toll-free quitline number in health warning labels on tobacco packaging was associated with a significant increase in overall call volumes to Ontario's Smokers' Helpline and in the number of new callers receiving treatment, as well as significant changes in the characteristics of new callers. The effect was positive and sustained. Future research should determine whether the increase in call volumes is sustained over longer periods and investigate the impact of the policy change in other provinces, given the differences that exist across Canada with regard to promotion of smoking cessation and tobacco taxation. Finally, future research needs to consider the impact of the policy on smoking cessation outcomes and the overall prevalence of smoking.

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