

# **Examining the Effectiveness of the 2012 Canadian Graphic Warning Label Policy Change by Sex, Income, and Education**

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# Declarations of interest

GTF and JFT have served as expert witnesses or consultants for governments defending their country's policies or regulations in litigation. GTF served as a paid expert consultant to the Ministry of Health of Singapore in reviewing the evidence on plain/standardized packaging. All other authors have no conflicts of interest to declare.

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# Background

- In 2000, Canada became the first country to include colored graphic warning labels (GWLs)
- In 2011, they replaced the 2000 GWL regulations with stronger requirements.



Health Effects – Mouth  
Canada  
2012



Health Effects – Mouth  
Canada  
2001

- Mixed evidence on the impact of GWLs across sex and socioeconomic (SES) groups
- Very few quasi-experimental studies

# Goals and Hypothesis

## Goals

- Assess the differential effectiveness of the 2012 Canadian GWL policy on cognitive and behavioral responses.
- Pre/post-policy survey data from adults who smoke in Canada (treatment country) and the United States (control country).

## Hypothesis

- The 2012 Canadian GWL policy changes would be associated with higher values for the label impact index (LII) and greater quit intentions, with stronger results among individuals from lower SES groups, when compared to the United States text-only warnings.

# Data source

- International Tobacco Control Four Country (ITC 4C) Surveys: waves 1–9 (2002–2015)
- International Tobacco Control Four Country Smoking and Vaping (ITC 4CV) Surveys: waves 1–3 (2016–2020)
- Canada and the United States.
- Adults aged 18 years and older who smoked more than 100 cigarettes in their lifetime and smoked at least once in the past 30 days.

# Measures

- Primary Outcomes
  - *Label Impact Index*: a composite measure of warning label salience, cognitive reactions, and behavioral reactions used in previous research.
    - *Continuous measure, with higher scores indicating a greater impact*
  - *Intention to quit smoking*: “Do you plan to quit smoking?” 1 (in the next month, in the next 6 months, sometime in the future after 6 months); 0 (otherwise).

# Measures

- Policy Exposure Variable

Interaction: a *country* variable \* a *pre/post*-policy variable

Pre/post-policy	Country	
	Canada (1)	United States (0)
before (0 = before March 2012)	0	0
after (1 = March 2012 and after)	1	0

**Before** : Canada (1\*0) and the United States (0\*0)

**After** : Canada (1\*1) and the United States (0\*1)

# Measures

- Third-Difference Variables
  - Sex (male/ female)
  - Education (low, medium, and high, not stated)
  - Annual household income (low, medium, and high, not stated).
- Control Variables
  - Third difference variables, age group, ethnicity, smoking status, use of vaping products, quit intentions (LII model only), time (survey waves), time-in-sample, survey mode (internet/phone), cigarette price per daily dose.



# Statistical Analyses

1. Unweighted sample distribution
2. LII mean scores and quit intentions prevalence by wave.
3. Two-way interaction controlled interrupted time series (CITS) model

- $\text{Logit}(\text{outcome}) = \beta_0 + \beta_1 \text{Country} + \beta_2 \text{Prepostpolicy} + \beta_3 \text{Country} * \text{Prepostpolicy} + \beta_4 \text{Agegroups} + \beta_5 \text{Sex} + \beta_6 \text{Income} + \beta_7 \text{Education} + \beta_8 \text{Survey mode} + \beta_9 \text{Smkstatus} + \beta_{10} \text{TIS} + \beta_{11} \text{Quit intentions} + \beta_{12} \text{Ethnicity} + \beta_{13} \text{Vaping} + \beta_{14} \ln(\text{Price}) + \beta_{15} \ln(\text{Price}) * \text{Country} + \beta_{16} \text{Wave} + \beta_{17} \text{Wave} * \text{Country}.$

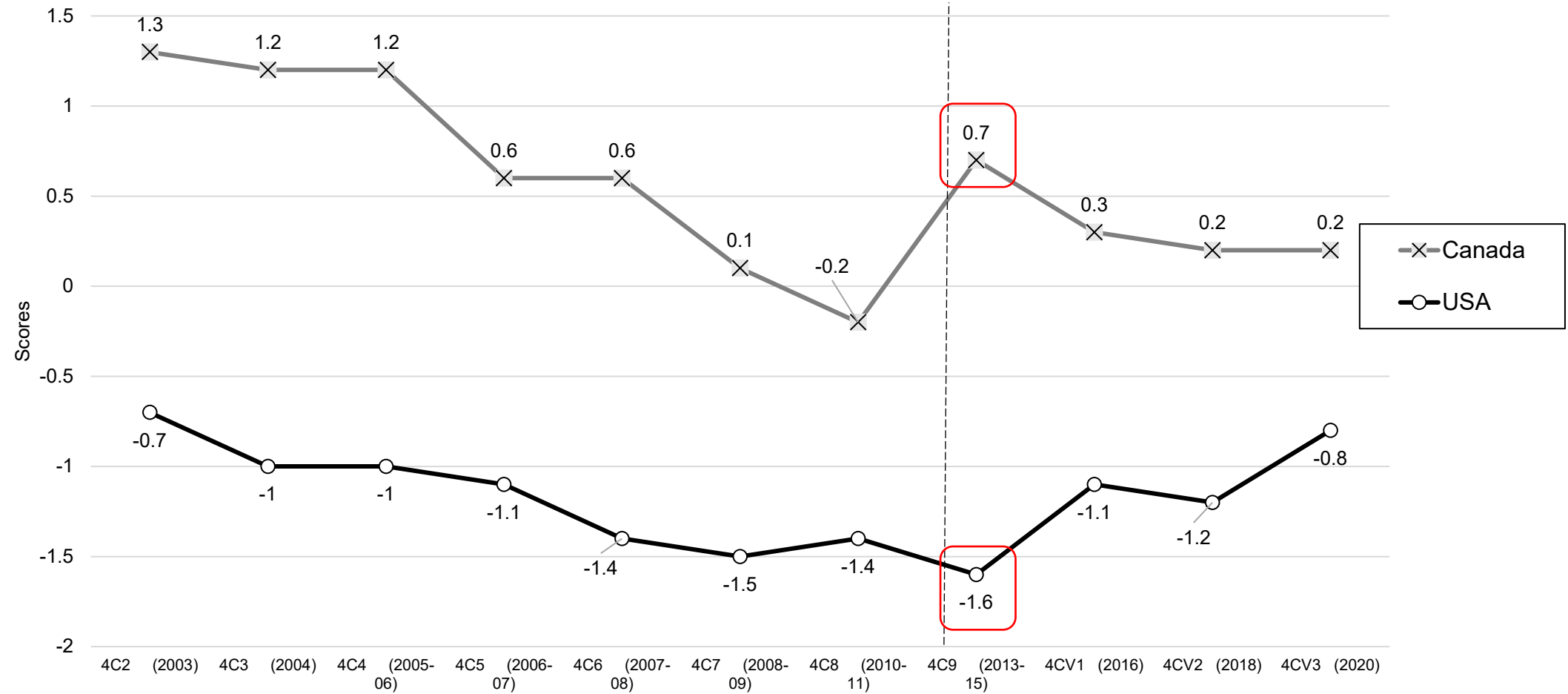
4. Three-way interaction model to estimate differences in the effects of the policy among sex, education, and income groups.

- $\text{Logit}(\text{outcome}) = \beta_0 + \beta_1 \text{Country} + \beta_2 \text{Prepostpolicy} + \beta_3 \text{Country} * \text{Prepostpolicy} + \beta_4 \text{Agegroups} + \beta_5 \text{Sex} + \beta_6 \text{Income} + \beta_7 \text{Education} + \beta_8 \text{Survey mode} + \beta_9 \text{Smkstatus} + \beta_{10} \text{TIS} + \beta_{11} \text{Quit intentions} + \beta_{12} \text{Ethnicity} + \beta_{13} \ln(\text{PricePerDose}) + \beta_{14} \ln(\text{PricePerDose}) * \text{Country} + \beta_{15} \text{Wave} + \beta_{16} \text{Wave} * \text{Country} + \beta_{17} \text{Country} * \text{Sex} + \beta_{18} \text{Prepostpolicy} * \text{Sex} + \beta_{19} \text{Country} * \text{Prepostpolicy} * \text{Sex}.$

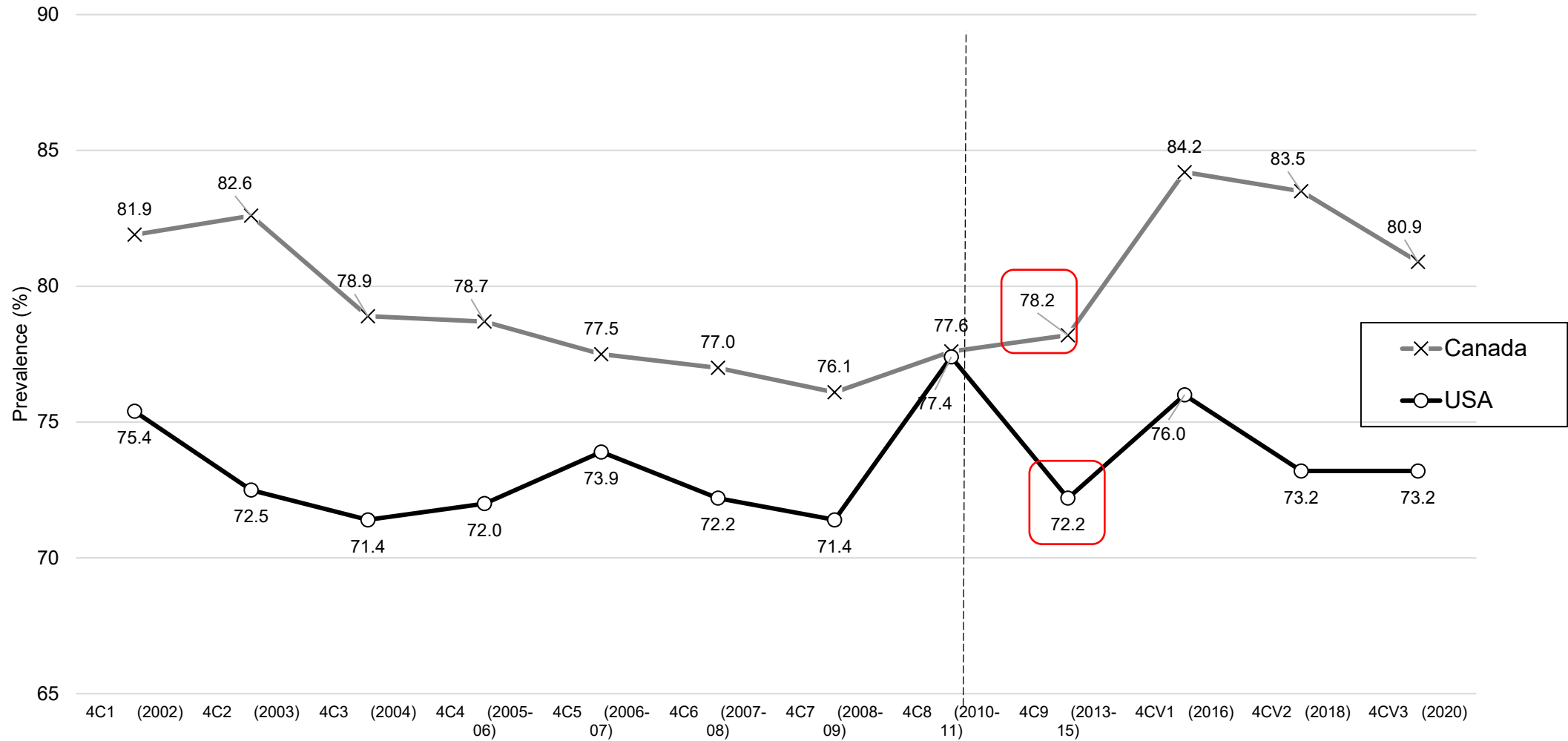
# Results: Sample Sizes and Sample Characteristics at Recruitment

Sample size (recruited / recontacted)	Canada		United States	
	N (11518)	%	N (12020)	%
<b>Sex</b>				
female	6052	52.5	6370	53.0
male	5466	47.5	5650	47.0
<b>Age group</b>				
18-24	2419	21.0	2241	18.6
25-39	3218	27.9	2888	24.0
40-54	3523	30.6	3490	29.0
55-max	2358	20.5	3401	28.3
<b>Ethnicity</b>				
White (CA & US)	9512	82.6	9133	76.0
Non-white (CA & US)	1903	16.5	2861	23.8
Don't know	103	0.9	26	0.2
<b>Income</b>				
Low	3580	31.1	4424	36.8
Medium	3498	30.4	3667	30.5
High	3536	30.7	3431	28.5
Not Stated	904	7.9	498	4.1
<b>Education</b>				
Low	4465	38.8	5000	41.6
Medium	4566	39.6	4650	38.7
High	2428	21.1	2358	19.6
Not Stated	59	0.5	12	0.1
<b>Smoking status</b>				
daily	9581	83.2	10440	86.9
non-daily	1937	16.8	1580	13.1

# Results: Label Impact Index Scores Trend, 2003-2020



# Results: Quit Intention Prevalence, 2003-2020



# Results: Controlled interrupted time series models - Label Impact Index by sex, education and income

Variable	Beta coefficient (95% CI)			
	Main model (Model 1)	Sex interaction (Model 2)	Education Interaction (Model 3)	Income Interaction (Model 4)
GWL Policy * Country		0.61(0.02-1.19)		
Canada after March 2012	<b>0.84(0.35-1.33)</b>	2.94(2.49-3.39)	0.62(-0.03-1.26)	1.09(0.42-1.77)
<b>Sex interaction</b>				
GWL Policy * Country * Female (Canada, female, after March 2012 policy)		0.50(-0.13-1.12)		
<b>Education interaction</b>				
GWL Policy *Country * education				
Canada, High school or less after March 2012			-0.52(-1.33-0.28)	
Canada, Some college/trade/technical school, after March 2012			-0.24(-1.01-0.54)	
<b>Income interaction</b>				
GWL Policy *Country * income				
Canada, Low, after March 2012				<b>0.80(0.05-1.54)</b>
Canada, Medium, after March 2012				0.65(-0.05 -1.35)

# Results: Controlled interrupted time series models – Quit intentions by sex, education and income

Variable	Odds Ratio (95% CI)			
	Main model (Model 1)	Sex interaction (Model 2)	Education Interaction (Model 3)	Income Interaction (Model 4)
GWL Policy * Country				
Canada after March 2012	1.89 ( 1.51 - 2.36)	1.98 ( 1.52 - 2.57)	2.10 ( 1.57 - 2.82)	2.04 ( 1.52 - 2.73)
<b>Sex interaction</b>				
GWL Policy * sex (Female, after March 2012 policy)		1.32 ( 1.08 - 1.60)		
<b>Education interaction</b>				
GWL Policy *Country * education				
Canada, High school or less after March 2012			1.54 ( 1.05 - 2.25)	
Canada, Some college/trade/technical school, after March 2012			1.44 ( 0.99 - 2.08)	
<b>Income interaction</b>				
GWL Policy *Country * income				
Canada, Low, after March 2012				1.15 ( 0.82 - 1.62)
Canada, Medium, after March 2012				1.13 ( 0.81 - 1.59)

# Discussion

- Significantly greater impact in noticing warning labels, thinking about quitting, thinking about the risks of smoking, forgoing a cigarette, and greater quit intentions among adults who smoke in Canada when compared to the United States.
- No difference in policy impact by sex
- Potentially positive equity impact – greater among adults who smoked from low-income and low-education groups than in high-income and high-education groups
- Together, these findings affirm and strengthen the need for countries to implement or maximize the size of GWLs, in line with the WHO FCTC.

# Strengths

- Quasi-experimental study design with a control group allows us to make stronger inferences

# Limitations & Future Studies

- Potential impact on responses for individuals who participated in more than one wave.
- Did not examine the impact of the GWL policy on quit success parallel to quit attempts.
- Did not assess the impact of specific types of GWL messages or designs.
- Potential synergies between the multiple policy interventions reduce the external generalizability of our findings.



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