

# Impact of the 2010 tobacco tax increase in Australia on short-term smoking cessation: a continuous tracking survey

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Tobacco tax increases have been identified as the most effective single intervention to reduce demand for tobacco,<sup>1</sup> with higher taxes associated with greater reductions in cigarette sales.<sup>2,3</sup> In the 2009 report of the Australian National Preventative Health Taskforce, the first recommendation for reducing tobacco consumption was to make tobacco products significantly more expensive. At the time, Australia was lagging behind international comparators, with a pack of 30 cigarettes costing \$13.50 in Sydney, compared with \$16 in Toronto (Canada) and \$20 in Dublin (Ireland).<sup>4</sup> On 30 April 2010, the Federal Government announced a 25% increase in tobacco tax, effective immediately, raising the price of an average pack of 30 cigarettes by around \$2.20. This was the first real-terms tobacco tax increase in Australia in a decade.

Most of the research on the link between tobacco tax increases and changes in cigarette consumption has used sales data<sup>5</sup> and smoking prevalence data.<sup>6–8</sup> Collecting population-based smoking cessation data at the time of a tobacco tax increase is difficult, because taxation policies are usually implemented rapidly. As a result, only a few studies have examined the impact of rising cigarette prices on individual-level measures of smoking cessation. One study compared the proportion of smokers reporting a quit attempt in the months before, and the month immediately after, a 95 cents per pack cigarette price increase in California;<sup>7</sup> there was a significant increase in cessation activity in the month after the increase.

The 2010 Australian tobacco tax increase occurred while the Tobacco Tracking Survey of the Cancer Institute NSW [New South Wales] was in progress. We therefore had a unique opportunity to track individual-level data to assess actual quitting behaviour in the months before and after the tax increase. Data collected in

## Abstract

**Objective:** To use population-level data to monitor the impact on smoking cessation activity of the April 2010 Australian tobacco tax increase.

**Design and setting:** The Cancer Institute NSW [New South Wales] Tobacco Tracking Survey (CITTS) is a continuous tracking telephone survey conducting about 50 interviews per week. Data from February to September in 2009 and 2010 were analysed (ie, data on people who quit smoking in the 3 months before and 5 months after the tax increase in 2010 were compared, and quitting activity over the same period in 2009 was also analysed).

**Participants:** Adult smokers and smokers who had stopped smoking in the previous 12 months; 2009 ( $n = 1604$ ); 2010 ( $n = 1699$ ).

**Main outcome measure:** Recent quitting (defined as stopping smoking or trying to quit within a 1-month period).

**Results:** 22% of the sample reported that they had quit smoking in May 2010, compared with 13% in April 2010 and 12% in May 2009. Respondents interviewed in the 3 months after the tax increase (May–July) were significantly more likely to report quitting than those interviewed in the 3 months before the tax increase (odds ratio, 1.84; 95% CI, 1.26–2.69;  $P < 0.01$ ). This increase in quitting activity was not sustained in the subsequent months (August–September).

**Conclusions:** The tobacco tax increase was associated with a short-term increase in the rate of smoking cessation among NSW adult smokers and recent quitters, suggesting that regular increases in tobacco tax may further encourage quitting activity.

2009 allowed a comparison of quitting patterns in the two consecutive years.

## Methods

### Procedure and participants

The Cancer Institute's Tobacco Tracking Survey (CITTS) is a continuous survey of NSW adults, both smokers and those who have quit smoking during the previous 12 months (recent quitters). The CITTS monitors smoking-related cognition and behaviour, as well as responses to changes in tobacco-control legislation and programs; 50 interviews per week are conducted by professional telephone interviewers across most weeks of the year. Households are recruited to the telephone survey using random digit dialling of landline telephone numbers, and participants are recruited by a random selection procedure.

For our study, analyses were limited to smokers and recent quitters interviewed between February and Sep-

tember in 2010 and in the same months in 2009.

- *Smokers* were defined as those who reported that they currently smoked cigarettes, pipes or other tobacco products daily, weekly, or less often than weekly.

- *Recent quitters* were defined as those who reported that they do not currently smoke at all, but have smoked in the past 12 months.

The method used for determining recent quitting activity is described in Box 1.

### Smoking and demographic covariates

Demographic characteristics — age, sex, household income, and level of education — were obtained from the survey. Postcodes were used with the Socio-Economic Indexes for Areas<sup>9</sup> to indicate socioeconomic status (SES) (dichotomised into low SES = quintiles 4–5; and moderate–high SES = quintiles 1–3).

For smokers, a heaviness of smoking index (HSI) was constructed using

**1 Determining recent quitting activity**

- Smokers were asked if they had ever tried to quit smoking and, if they had tried (at least once), when they last tried to quit (in the past 2 weeks; in the past month; in the past 6 months; in the past 12 months; over 12 months ago).
- Smokers who had quit in the previous 12 months (recent quitters) were asked how long ago they quit smoking (in the past 2 weeks; in the past month; in the past 6 months; in the past 12 months; over 12 months ago).
- For each calendar month, we could then calculate the proportion of smokers who made an attempt to quit (either successful or unsuccessful) from the pool of smokers available to quit (ie, current smokers and recent quitters who quit within the past month).
- Quitting activity was ascribed to specific months depending on the timing of the interview — eg, respondents were classified as having quitting activity in May if they were:
  - interviewed in the first 2 weeks of May and had quit or attempted to quit in the past 2 weeks;
  - interviewed in the last 2 weeks of May and had quit or attempted to quit in the past month (including the last 2 weeks); or
  - interviewed in the first 2 weeks of June and had quit or attempted to quit in the past month, but not in the past 2 weeks.
- Recent quitters who stopped smoking more than 1 month before their interview were excluded, as they were not available to make a quit attempt during that month.
- Smokers who had made a quit attempt in the 6 months before interview, but not in the previous month, were also excluded because their quit attempt could not accurately be ascribed to any particular month, and we had no information on how long they had been abstinent.
- Smokers who had made a quit attempt in the past 12 months, but not within the past 6 months, were included as current smokers with no quit attempt, as they were available to make a quit attempt throughout the study period. ◆

a short form of the Fagerström tolerance questionnaire,<sup>10</sup> with slight modification. The HSI is calculated as a combination of time to first cigarette after waking and number of cigarettes smoked per day, and was divided into three categories (low, moderate, high).

**Statistical analyses**

The proportions of smokers and recent quitters reporting quitting activity in each month were calculated, with 95% confidence intervals. For a seasonal comparison, these calculations were also done for the same months in 2009. Multiple logistic regression analysis was conducted to predict quitting activity in 2010 using demographic characteristics as covariates and month of quitting as the indicator. The months before and after the tax increase were represented by a three-level term. We coded quitting activity that occurred: (i) in the 3 months before the increase as “pre-tax increase”; (ii) in the 3 months after the tax increase as “immediate post-tax increase”; and (iii) from 4 to 5 months after the tax increase as “delayed post-tax increase”. To test whether any differences in quitting activity between these months were a result of typical seasonal variation, this model was also fitted to the 2009 data.

Since the HSI was not available for recent quitters who were included in this analysis, the analysis was also run using smokers only and including the HSI to verify that differences in quitting activity across the months were not due to differences in heaviness of smoking. This analysis showed the same pattern of results, and so the model including recent quitters (without the HSI) is reported. We also tested all interactions between months of quitting activity and demo-

graphic variables to determine whether the tax increase might have affected some smokers differentially. No interactions were significant, so the model is reported without them.

Owing to a slight overrepresentation of older and women smokers, weights were applied in descriptive analyses to adjust for sex, age and region, according to the NSW population,<sup>11</sup> to provide estimates of quitting activity in this population. Unweighted data were used for regression analyses. All analyses were conducted using SPSS version 18.0 (IBM, Armonk, NY, USA).

**Ethics approval**

The CITTS is approved by the NSW Population Health Services Research Ethics Committee.

**Results**

In 2009, of 67 753 telephone numbers randomly selected for the survey, 41 689 (62%) could be assessed for eligibility (others were non-contactable or non-respondents) and eligible individuals were contacted at 7246 (17%) of these. Of those eligible, 2500 (35%) people consented to participate and completed the survey. Rates of consent were consistent across the months; the final sample size for February to September 2009 was 1604.

From January to September 2010, 47 243 telephone numbers were randomly selected, 28 287 (60%) could be assessed for eligibility and 4564 (16%) eligible individuals were identified. Of these, 1792 (39%) consented and completed the survey. The final sample size for February to September 2010 was 1699. The demographic characteristics and smoking data for the two samples are shown in Box 2.

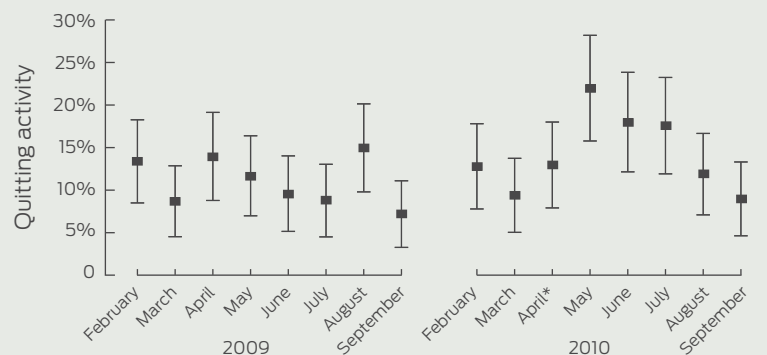
In the month after the tax increase, 22% of current smokers quit or attempted to quit smoking, compared with 13% in the previous month. Box 3 shows the proportions of smokers and recent quitters who reported quitting activity in the months before and after the tax increase in 2010, and in the corresponding months in 2009. After the tax rise, there was an almost 70% increase in the rate of quitting activity from April to May. This increase was sustained at least some-

**2 Demographic characteristics and smoking data — 2010 and 2009 samples\***

Characteristic	Respondents	
	2010 (n = 1699)	2009 (n = 1604)
<b>Sex</b>		
Male	49%	50%
<b>Age (years)</b>		
18–29	20%	20%
30–55	48%	48%
> 55	32%	32%
<b>Education</b>		
< Year 12	29%	32%
Year 12/Technical college	47%	44%
Tertiary	24%	24%
<b>Income (\$)</b>		
< 40 000	38%	40%
40 000–80 000	30%	32%
> 80 000	32%	28%
<b>Socioeconomic status†</b>		
Low	44%	44%
<b>Current smoker</b>	(n = 1421)	(n = 1367)
Yes	84%	85%
<b>Heaviness of smoking index</b>		
Low	36%	37%
Moderate	42%	40%
High	22%	23%

\* Estimates use weighted data. † Socioeconomic status indicated by postcode and Socio-Economic Indices for Areas.<sup>9</sup> ◆

### 3 Percentage of smokers and recent quitters (95% CI) reporting quitting activity in the months before and after the 2010 tobacco tax increase, and in the corresponding months in 2009



\* Tax increase 30 April 2010.

what throughout June and July before decreasing again in August and September. For comparison, in May 2009, only 12% of current smokers reported any quitting activity.

Multiple logistic regression analyses tested whether respondents interviewed in the months after the tax increase were more likely to report recent quitting activity compared with the months before the tax increase, controlling for individual characteristics (sex, age, socioeconomic status, income and education). The results, shown in Box 4, indicated that respondents interviewed in the 3 months immediately after the tax increase were significantly more likely to report recent quitting activity than those interviewed before the tax increase, but those interviewed 4–6 months after the increase were no more likely to report quitting activity. For comparison, the same multiple logistic regression model was fitted to the 2009 data (Box 4). This analysis showed no significant differences in quitting activity for respondents interviewed in May–July compared with those interviewed in the previous months.

## Discussion

To date, very few studies able to examine associations between a cigarette tax increase and smoking cessation have been conducted using population-based survey data. Our findings indicate that quitting activity increased substantially in the months immediately after the 2010 tax increase, suggesting a direct link

between the price increase and smoking cessation. By examining individual-level data, this result extends previous research linking tax increases to decreases in cigarette sales data,<sup>2,3</sup> and to smoking prevalence.<sup>6</sup> Extrapolating from our data, if 22% of the NSW smoking population quit or

attempted to quit in the month of May 2010, this would be more than 200 000 smokers, almost double the number who stopped smoking or tried to quit in April before the tax increase.

Despite the increase in quitting activity in the months immediately after the tax increase, after 3 months quitting activity fell back to previous levels. A possible explanation for this might be that tax increases provide an impetus for smokers who are ready to quit, reinforcing their latent motivations. Once the smokers who are ready to quit make an attempt, the pool of ready-to-quit smokers can become depleted, and further increases in the rate of quit attempts may be unlikely. Our study, however, could not investigate this possibility, which would require an analysis of whether reductions in smoking prevalence are sustained after a tax increase. Additionally, our study did not examine the effect of the tax

### 4 Results of logistic regression analyses predicting quitting activity before and after the tobacco tax increase in 2010 and in the same period in 2009

Category	Percentage of respondents with recent quitting activity by category			
	In 2010 (n = 1157)*	Odds ratio (95% CI)	In 2009 (n = 1167)*	Odds ratio (95% CI)
<b>Sex</b>				
Female	16%	1.00	13%	1.00
Male	13%	0.89 (0.64–1.24)	9%	0.68 (0.47–1.00)
<b>Age (years)</b>				
18–29	16%	1.00	9%	1.00
30–55	15%	0.97 (0.49–1.91)	10%	0.89 (0.41–1.99)
> 55	14%	0.90 (0.48–1.70)	12%	0.94 (0.45–1.97)
<b>Education</b>				
< Year 12	12%	1.00	12%	1.00
Year 12/Technical college	16%	1.35 (0.90–2.03)	12%	1.15 (0.76–1.76)
Tertiary	17%	1.67 (1.02–2.72) <sup>†</sup>	9%	0.82 (0.47–1.42)
<b>Income (\$)</b>				
< 40 000	16%	1.00	13%	1.00
40 000–80 000	13%	0.82 (0.54–1.22)	9%	0.68 (0.43–1.07)
> 80 000	15%	0.86 (0.56–1.31)	12%	0.82 (0.51–1.32)
<b>Socioeconomic status</b>				
Low	16%	1.00	10%	1.00
Moderate–High	14%	0.96 (0.69–1.36)	12%	1.39 (0.96–2.03)
<b>Period of quitting activity<sup>†</sup></b>				
February–April	12%	1.00	12%	1.00
May–July	19%	1.84 (1.26–2.69) <sup>§</sup>	12%	0.98 (0.65–1.48)
August–September	12%	1.23 (0.78–1.91)	9%	0.93 (0.58–1.49)
<b>Model <math>\chi^2</math></b>		<b>16.17<sup>‡</sup></b>	<b>12.79</b>	

\* Sample sizes vary from the total because of missing values on some variables and respondents being excluded from analyses due to coding of recent quitting activity, as described in Box 1. <sup>†</sup> For 2010, February–April = pre-tax increase; May–July = immediate post-tax increase; and August–September = delayed post-tax increase. <sup>‡</sup>  $P < 0.05$ . <sup>§</sup>  $P < 0.01$ .

increase on rates of smoking uptake, which is another possible response to taxation, and one that may not decrease over time in the same way as the effect on quitting activity. Nonetheless, the pattern of increased quitting activity returning to pre-tax levels after 3 months highlights the need for regular tax increases to motivate smokers to act on their desire to quit.

Other studies have used surveys of smokers to explore cessation activity stimulated by tax increases. In a survey of Massachusetts smokers after a 25 cents per pack tax increase in the early 1990s, 44% of smokers who quit after the tax rise reported that the price increase had had at least some effect on their quitting, and 35% of continuing smokers reported that the tax increase made them consider quitting.<sup>12</sup> However, this survey relied on retrospective recall and was conducted about 9–15 months after the increase. In population surveys conducted after five successive tax increases in Germany, 4%–8% of smokers reported that the tax increases had prompted them to quit, with an increased likelihood of cessation activity associated with a greater price increase.<sup>13</sup> Recent evidence from the United States and Canadian International Tobacco Control (ITC) projects has shown that smokers living in areas with higher tobacco prices are more motivated to quit, and have an increased likelihood of actually quitting.<sup>14</sup> In the ITC survey in Mexico, the number of smokers reporting serious attempts to quit in the past year increased in the year after a tax rise; however, this study was also conducted many months after the tax increase and relied on retrospective recall.<sup>15</sup>

Although our study presented a unique opportunity to assess quitting activity in NSW after the tobacco tax increase, it is subject to certain limitations. First, the data are based on retrospective reports of quitting as opposed to a longitudinal follow-up of individuals who quit. Second, the somewhat low response rate of the survey might have led to some bias in

the sample composition. However, this response rate is similar to that of other population telephone surveys in Australia<sup>16</sup> and the US,<sup>17</sup> and recent studies have indicated that differences in response rates have frequently shown only minor effects on key estimates.<sup>18</sup> Additionally, the overall rates of quitting in our sample are similar to those of larger population surveys of NSW smokers.<sup>19</sup> Finally, our analyses did not account for variations in other policy or program influences on smokers during this period, such as media campaigns or legislation. However, there were no substantial changes to tobacco control policies implemented in NSW in May 2010.

The results of our study show that the 2010 tax increase was associated with an increase in the number of smokers making quit attempts and quitting, but this activity was not sustained in the long term. In 2009, the National Preventative Health Taskforce proposed that smoking prevalence in Australia could be reduced to 9% by introducing, among other things, a 49% increase in the average price per cigarette (from \$0.45 to \$0.67, or greater than \$20 per pack).<sup>4</sup> The tax rise in 2010 increased the price by 25%. If the tax was further raised to the rate that the Taskforce recommended, the increase in quit attempts may contribute to a substantial decrease in smoking prevalence. Such tax increases, however, need to be accompanied by appropriate cessation, prevention and education efforts to stimulate interest in quitting and support quit attempts.

**Competing interests:** No relevant disclosures.

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- 1 Chaloupka FJ. Macro-social influences: the effects of prices and tobacco-control policies on the demand for tobacco products. *Nicotine Tob Res* 1999; 1 Suppl 1: S105-S109.
- 2 Gallet CA, List JA. Cigarette demand: a meta-analysis of elasticities. *Health Econ* 2003; 12: 821-835.
- 3 Farrelly M, Pechacek TF, Chaloupka F. The impact of tobacco control program expenditures on aggregate cigarette sales: 1981-2000. *J Health Econ* 2003; 22: 843-859.
- 4 Preventative Health Taskforce. Australia: the healthiest country by 2020. Technical Report 2. Tobacco control in Australia: making smoking history. Including addendum for October 2008 to June 2009. Prepared for the Preventative Health

Taskforce by the Tobacco Working Group. Canberra: Commonwealth of Australia, 2009 <http://www.health.gov.au/internet/preventativehealth/publishing.nsf/Content/tech-tobacco> (accessed Jul 2011).

- 5 Glantz SA. Changes in cigarette consumption, prices, and tobacco industry revenues associated with California's Proposition 99. *Tob Control* 1993; 2: 311-314.
- 6 Scollo M, Younie S, Wakefield M, et al. Impact of tobacco tax reforms on tobacco prices and tobacco use in Australia. *Tob Control* 2003; 12 Suppl 2: ii59-ii66.
- 7 Reed MB, Anderson CM, Vaughn J, Burns DM. The effects of cigarette price increases on smoking cessation in California. *Prev Sci* 2008; 9: 47-54.
- 8 Martire KA, Mattick RP, Doran CM, Hall WD. Cigarette tax and public health: what are the implications of financially stressed smokers for the effects of price increases on smoking prevalence. *Addiction* 2010; 106: 622-630.
- 9 Australian Bureau of Statistics. Census of population and housing: socio-economic indexes for areas (SEIFA), Australia - data only, 2006. Canberra: ABS, 2008. (ABS Cat. No. 2039.0.) <http://www.abs.gov.au/ausstats/abs@.nsf/mf/2039.0.55.001> (accessed Jul 2011).
- 10 Heatherton TF, Kozlowski L, Frecker RC, Fagerström KO. The Fagerström test for nicotine dependence: a revision of the Fagerström tolerance questionnaire. *Br J Addict* 1991; 86: 1119-1127.
- 11 Australian Bureau of Statistics. Population by age and sex, Australian states and territories, June 2006. Canberra: ABS, 2007. (ABS Cat. No. 3201.0.) <http://www.abs.gov.au/Ausstats/abs@.nsf/mf/3201.0> (accessed Jul 2011).
- 12 Biener L, Aseltine RH Jr, Cohen B, Anderka M. Reactions of adult and teenaged smokers to the Massachusetts tobacco tax. *Am J Public Health* 1998; 88: 1389-1391.
- 13 Hanewinkel R, Isensee B. Five in a row - reactions of smokers to tobacco tax increases: population-based cross-sectional studies in Germany 2001-2006. *Tob Control* 2007; 16: 34-37.
- 14 Ross H, Blecher E, Yan L, Hyland A. Do cigarette prices motivate smokers to quit? New evidence from the ITC survey. *Addiction* 2010; 106: 609-619.
- 15 Saenz-de-Miera B, Thrasher JF, Chaloupka F, et al. Self-reported price of cigarettes, consumption and compensatory behaviours in a cohort of Mexican smokers before and after a cigarette tax increase. *Tob Control* 2010; 19: 481-487.
- 16 Thompson ME, Fong GT, Hammond D, et al. Methods of the International Tobacco Control (ITC) Four Country Survey. *Tob Control* 2006; 15 Suppl 3: iii12-iii18.
- 17 Cantor D, Coa K, Crystal-Mansour S, et al. National Cancer Institute. Health information national trends survey (HINTS) 2007. Final report. February 2009. <http://hints.cancer.gov/docs/HINTS2007FinalReport.pdf> (accessed Jul 2011).
- 18 Keeter S, Miller C, Kohut A, et al. Consequences of reducing nonresponse in a national telephone survey. *Public Opin Q* 2000; 64: 125-148.
- 19 Cancer Institute NSW. New South Wales Smoking and Health Survey 2009. Sydney: Cancer Institute NSW, 2009. <http://www.cancerinstitute.org.au/publications/i/new-south-wales-smoking-and-health-survey-2009> (accessed Jul 2011). □