

Cancer Council Victoria comments on

Underwood D, Sun S, and Welters RAMHM. The effectiveness of plain packaging in discouraging tobacco consumption in Australia. *Nature Human Behaviour*, 2020. Available from: <https://doi.org/10.1038/s41562-020-00940-6>

I. Overview

This paper attempts to evaluate the impact of plain packaging in Australia by comparing what happened to prevalence, spending and cigarette consumption in Australia with what happened to these outcomes in another country that was similar in every respect other than the plain packaging policy.

The study selects New Zealand as the comparator, and the entire study rests on the assumption that “the timing of introduction of plain packaging is the key difference between the tobacco control measures of the two countries” (near end of 9th page). **But that assumption is unfounded.**

While New Zealand is indeed very similar to Australia in many ways, **the assumption that it is “almost identical” is not justified in one crucial respect that completely undermines the validity of this study and the authors’ conclusions about the impact of plain packaging.**

Tobacco taxes started going up annually in New Zealand from January 2011, just short of three years earlier than they did in Australia (in December 2013), and right in the period *before, during and after* plain packaging was being introduced in Australia in late 2012. **So ... the timing of introduction of annual tax increases is in fact another crucial difference between the countries.**

The study concludes that

- i. the greater fall in smoking prevalence in Australia than New Zealand was not statistically significantly greater
- ii. that the drop in expenditure on tobacco products in Australia was substantially greater than in New Zealand but
- iii. that cigarette consumption per smoker increased relative to New Zealand.

In light of the problem of comparability on the issue of timing of introduction of tax increases, a fairer conclusion of the data graphed in the paper would be as follows.

- Smoking prevalence declined in Australia no less over the period of introduction of plain packaging than it did in New Zealand, despite annual tax increases starting earlier in New Zealand.
- The drop in expenditure on tobacco products accords with the marked decline in tobacco products cleared for payment of excise and customs duty in Australia over the period and is indicative of declines in both prevalence and consumption of tobacco products.
- Weekly cigarette consumption by smokers may have started falling earlier in New Zealand than it did in Australia.¹ The authors interpret their data (which show a decline between 2011 and 2012 in numbers of cigarettes smoked by smokers per week in New Zealand and no decline in Australia) as a 6.5% *increase* in cigarette consumption due to plain packaging in Australia. But obviously the earlier fall in their consumption measure is much more likely to be due to the earlier timing of the introduction of annual tax increases in New Zealand.

¹ But note also that the authors used two different ways of calculating weekly consumption in the two countries, and the estimates in Australia are substantially lower than those published in government surveys. It seems likely that the conversion of RYO tobacco to cigarette equivalents was treated differently between the two countries. The proportion of smokers using RYO tobacco in preference to ready-made cigarette increased in both countries over the period, so that any underestimation of the number of cigarettes made from RYO tobacco in New Zealand would have become more pronounced over time and particularly following tax increases when many smokers make the switch to the cheaper product type.

Findings from well-designed studies assessing the impact of plain packaging in Australia

Smoking prevalence

Expert economic analysis of the plain packaging legislation commissioned by the Australian Government using monthly smoking prevalence data found that

“in comparing the 34 months prior to the implementation of tobacco plain packaging and enlarged graphic health warnings in December 2012, and the 34 months following the implementation of these measures:

- there was a “**statistically significant** decline in smoking prevalence [among Australians aged 14 years and over] of 0.55 percentage points over the post-implementation period, relative to what the prevalence would have been without the packaging changes”; and
- this decline accounts for approximately one quarter of the total decline in average prevalence rates observed”

Long term trends in cigarette consumption per smoker

Short-term changes in numbers of cigarettes smoked per day by each smoker is not an ideal indication of policy success because this measure could go up when lighter smokers drop out of the smoking population. But, in any case, Australia’s National Drug Strategy Survey (which is larger than the survey relied on by the authors in this study) shows that *cigarettes per smoker per day* in Australia fell markedly between 2010 and 2013 and continues to decline.

Per capita tobacco consumption

Number of cigarettes per day across the whole population is a much better indicator of overall tobacco use. Official government sources demonstrate that overall *per capita* consumption of tobacco declined markedly in Australia after the introduction of plain packaging and has continued to fall with annual tax increases. Treasury data show that excise and customs clearances of cigarettes and RYO cigarette equivalents were almost 30% less *per capita* in Australia in 2017 than they were in 2011.

Overall conclusion of impact of plain packaging in Australia

Tobacco use is declining in both Australia and New Zealand thanks to strong tobacco control policies in both countries.

II. More detailed analysis

The Underwood *et al* paper compares changes between Australia and New Zealand between 2002 and 2017 in

- smoking prevalence
- expenditure on smoking and
- expenditure on smoking as a percentage of household consumption and
- number of cigarettes smoked each week.

It asks whether the introduction of Australia's plain packaging law at the end of 2012 was associated with greater change in these four measures in Australia than occurred in New Zealand, controlling for economic and demographic factors and **assuming that tobacco control policy in New Zealand was essentially the same as in Australia other than for plain packaging.**

While the paper undertakes some impressive-looking analysis of economic factors, and while New Zealand is indeed very similar to Australia in many ways, **the assumption that tobacco control policy prior to plain packaging was near-identical in the two countries is not justified in one crucial respect that completely undermines the validity of this study.**

Tobacco tax is universally acknowledged as being the single most important variable that drives down tobacco use. However, different timing of tax increases in New Zealand and Australia means that tobacco control policies in the two countries cannot be considered identical.

The authors fail to report in the paper that New Zealand implemented major 10% compounding real increases in tobacco tax [on 1st January 2011, 1st January 2012 and 1st January 2013](#), (the year before, the year of and the year after introduction of plain packaging in Australia at the end of 2012). These led to major increases in the price of tobacco products each year over that period. Australia by contrast had no real tax increases over the 43-month period between 29 Apr 2010 and 1 Dec 2013.²

There is no discussion about these critical differences between the two countries in either the section on Robustness on page 10, or in Table 5 which notes similarity between the countries on other tobacco control policies such as health warnings and advertising bans.³ The discussion about robustness concentrates not on the suitability of New Zealand *per se*, but rather on its suitability comparable to UK and Canada. The tax increases that occurred annually from January 2011 in New Zealand and from December 2013 in Australia are included in one of the columns in the data file for the study.

Despite the clear differences in timing of commencement of the tax increases in the two countries, the authors conclude that they are unable to include price or tax in their analysis of differences between the countries on their four chosen measures, controlling for economic variables. On the 10th page of the paper they state:

“Note that in equation (1) conceptually, the price of tobacco (or tax) and education are expected to influence smoking behaviour (for example, see refs.32,33). We do not include these control variables owing to a high correlation with the time trend (correlation >0.94).”

On the 11th page the authors repeat

“In Tables 1-4 we report regression results of different specifications starting from a parsimonious model that only included the two dummy variables and their interaction term (the first specification) to a full model with all four control variable (the final specification that included time, GDP per capita, inflation and population growth).”

² *Taxes in Australia were indexed in line with price increases each February and August over that period. They have been indexed in line with wages growth twice yearly since September 2014

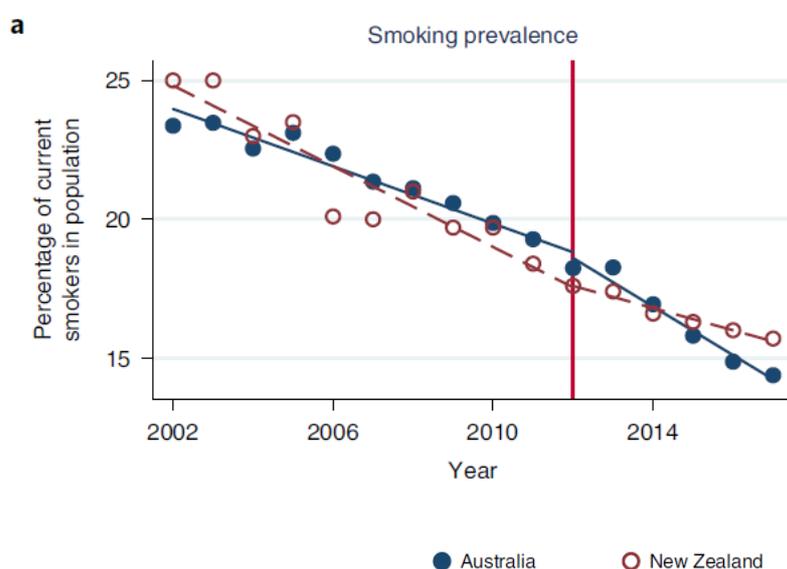
³ Table 5 states that both countries had anti-tobacco campaigns pre the plain packaging policy. Another considerable weakness of this study is that it fails to quantify the level of spending on such campaigns which is a crucial factor in determining their effectiveness. Investment in anti-tobacco campaigns was markedly low in Australia following the period of introduction of plain packaging – see Figure 14.3.1 <https://www.tobaccoinaustralia.org.au/chapter-14-social-marketing/14-3-public-education-campaigns-to-discourage-smoking>

1. Specification of policy and control variables

Plain packaging policy was implemented in Australia in the final 3 months of 2012 and yet in the modelling in this study, the policy is assumed not to have been implemented until 2013. This ignores the likely effects on population behaviour in 2012 both during the first few months of introduction, and also that resulted from the substantial publicity and media coverage about smoking harms and about the policy in the lead up to its implementation.

1. Prevalence

As is evident in the authors' graph (**Fig 1a**), prevalence of smoking has declined in both countries in the two decades since 2002. For prevalence to have declined in Australia no less than it declined in New Zealand over that crucial period of major tax increases in New Zealand (and no real increases in taxes in Australia) is suggestive of a contribution from the plain packaging policy.



2. Expenditure on tobacco

The paper finds clear evidence of steeper declines since the introduction of plain packaging in Australia in household expenditure on tobacco, and continuing declines in household spending on tobacco as a percentage of total household spending (**graphs b and c**).

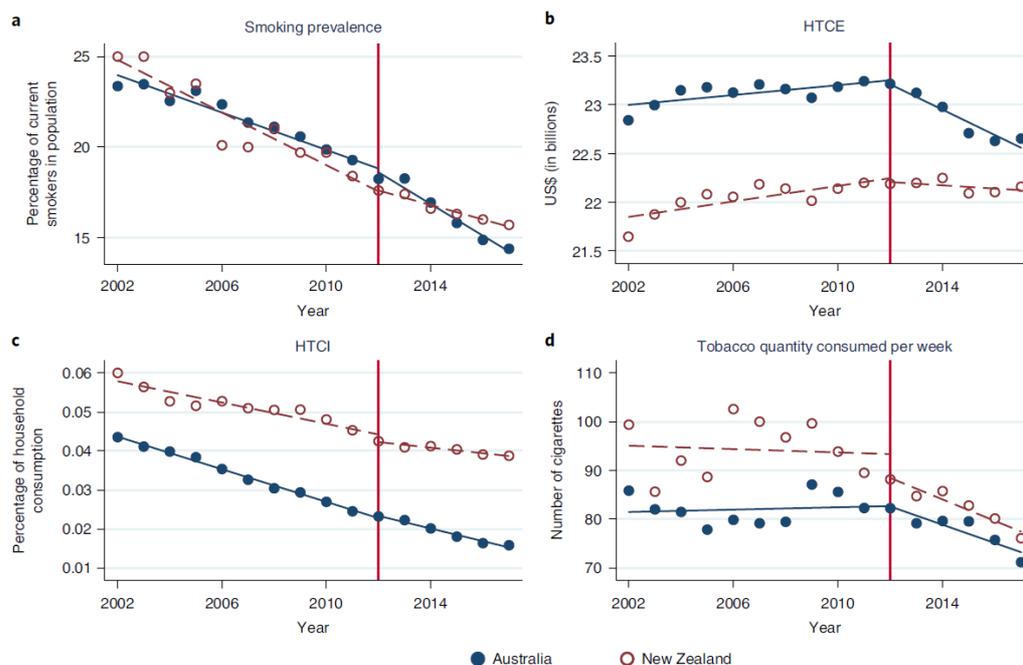


Fig. 1 | Time trends in tobacco outcomes for Australia and New Zealand before and after the TPP Act. a-d, Changes in tobacco outcomes for smoking prevalence (a), HTCE (b), HTCI (c), and quantity of cigarettes consumed per week (d) for Australia and New Zealand. The red line in each graph shows the year in which the TPP Act was implemented (2012). HTCE values have been adjusted for inflation, measured in US dollars at 2010 prices, converted to natural log. $n = 32$ for all panels.

3. Number of cigarettes per week

The authors claim that plain packaging has *increased* the number of cigarettes smoked in Australia by 6.5 per week. This non-intuitive interpretation of the data in Figure 1d (which clearly shows declines from 2012 in both countries) results from the statistical comparison with New Zealand.

The authors are saying that plain packaging increased weekly consumption in Australia because... weekly numbers of cigarettes consumed dropped sharply in New Zealand but not in Australia at that time.

As indicated below, there seems to be a major problem in the authors' calculation of weekly consumption in Australia, which is more than 20% lower than that recorded in official government surveys. But even taking their data at face value, there is another much simpler and more plausible explanation. **Estimated numbers of cigarettes smoked per week by New Zealand smokers fell sharply between 2011 and 2013 because of the large tax increases over that period.**

III. More detailed problems with the data

Prevalence

1.1 Probable lack of comparability between surveys in Australia and New Zealand

The authors fail to state in the paper which surveys they have used to generate figures for smoking prevalence, and fail to provide any data about age ranges, response rates and sample sizes. For a paper purporting to offer a rigorous evaluation of a national policy, this is a serious omission.

Given that they say the data come from the Australian Bureau of Statistics and Statistics New Zealand, presumably they have used the Australian National Health Survey and the New Zealand Health Survey.

The New Zealand survey reports on prevalence for those aged 15+ years. The authors do not say whether the Australian data was also 15+ years or whether it was 18+ years, which is what the Australian Bureau of Statistics more commonly reports on in its data files.

Note: Smoking in Australia is falling faster in younger age groups, so that prevalence for those in the population aged 15+ years is falling faster than prevalence for the population of those aged 18+ years.

1.2 Lack of precision in Australian prevalence estimates

The Australian National Health Survey was only conducted four times over that period (2004-05, 2007-08, 2011-12 and 2014-15) and not closely adjacent to the actual post-implementation phase of the plain packaging policy (October to December 2012).⁴

The authors say that in addition to using the “ABS data”, they ‘extracted’ annual data from the Roy Morgan Research survey from an ‘infographic’ published on a Cancer Council website.

<https://www.tobaccoinustralia.org.au/chapter-1-prevalence/1-3-prevalence-of-smoking-adults>

The authors do not disclose how they integrated the estimates from the two different surveys.

It is important to note that:

- **No data points are available on this infographic** (Figure 1.3.3), so the figures ‘extracted’ would necessarily be rough
- These figures are for those aged 18+ years so would have been naturally slightly higher and slower-changing than any survey data based on a population aged 15+ years
- **They are not raw figures of monthly smoking prevalence ... they are a 12-month running average.** So the figure for December 2012 is not the recorded prevalence in December 2012 (when the policy was introduced) ... it is an average of all the figures from the preceding 12 months.

These concerns about the data from the “infographic” would surely preclude their use as outcome measures in a rigorous analysis of a shock ‘interruption’. This alone casts doubt on the validity of conclusions of the study about the impact of plain packaging on smoking prevalence in Australia.

⁴ Australian Bureau of Statistics. 4364.0.55.001 - National Health Survey: First Results, 2014-15 2015. Available from: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4364.0.55.001Main+Features12014-15?OpenDocument>

2. Number of cigarettes per day

2.1 Validity of estimated numbers of cigarettes per day as a measure of policy impact

The authors put much weight on reported numbers of cigarettes per day by smokers saying ...'the number of cigarettes consumed weekly by a current smoker is logically the best indicator of change overall and individual tobacco consumption'.

However cigarettes consumed per day by current smokers is actually not an ideal indicator of policy impact.

First and most importantly, the average number of cigarettes per day is determined both by the numbers of cigarettes people smoke, and by the relative proportions in the population of

- *occasional* versus *regular* smokers, and—among regular smokers
- the proportion of *light* versus *moderate* and *heavy* smokers.

A policy that successfully prompted quitting could theoretically be followed by an *increase* in the proportion of regular smokers and heavy smokers in the population.... because more occasional and light smokers drop out of the smoking population. This, of course, would *increase* the average daily cigarette consumption across the population, even if not a single smoker remaining in the population increased their consumption by even one cigarette per day.

Conceptually the correct measure to have used to have assessed the impact of this policy at a population level would have been *per capita* number of cigarettes consumed per day in each of the countries (i.e. cigarettes per *person* 15 years and over) rather than cigarettes per *smoker*.

Per capita quantities of tobacco products cleared for payment of duty in Australia fell markedly in 2012. *Per capita*, the number of cigarettes or cigarette equivalents sold in Australia has fallen by about 30% between 2011 and 2017.

Table 2.2.5b
Cigarettes and smoking tobacco on which duties were levied (excise and customs combined)—total cigarettes (ready-made and roll-your-own) and cigarettes per person 15 years and over, 2010 to 2017 (estimated numbers of cigarettes)

Year ending 31st December	Number of cigarettes per year			Estimated number per person per year		
	Cigarettes	Estimated no. of RYO cigarettes assuming 0.8 grams of smoking tobacco per cigarette)	Total estimated cigarettes (ready-made and roll-your-own)	Ready-made cigarettes only	Cigarettes: ready-made and RYO (assuming 0.8g per cigarette)	Cigarettes: ready-made and RYO (assuming 0.6g per cigarette)
2011	19,662,109,820	2,333,141,250	21,995,251,070	1,103	1,234	1,278
2012	19,758,102,477	2,462,210,000	22,220,312,477	1,089	1,225	1,270
2013	18,941,786,070	2,529,441,250	21,471,227,320	1,026	1,163	1,208
2014	17,296,604,371	2,475,743,750	19,772,348,121	922	1,054	1,098
2015	16,582,010,218	2,491,191,250	19,073,201,468	871	1,002	1,046
2016	15,812,377,167	2,736,607,500	18,548,984,667	818	959	1,007
2017	14,200,342,970	2,696,491,250	16,896,834,220	722	859	904
Change between 2011 and 2017	-28%	+16%	-23%	-35%	-30%	-29%

Sources:

Australian Government. Total tobacco clearances data. 30 Oct FOI req 1803 ¹¹⁷

Australian Government. Net Clearances of Tobacco Products. 28 Oct FOI req 1970 ¹¹⁸

Australian Government. Monthly data on the net clearances of all tobacco products from ATO and Customs for the period July 2015 - December 2016. 30 Jun FOI req 2146 ¹¹⁹

Australian Government. Total tobacco clearances data. 3 Aug FOI req 2350 ¹²⁰

3101.0 Australian Demographic Statistics - Estimated Resident Population 15+, June 2018, ¹²¹

2.2 Tobacco products dutiable per smoker

See Table 2.2.5b <https://www.tobaccoinaustralia.org.au/chapter-2-consumption/2-2-dutiable-tobacco-products-as-an-estimate-of-to>

2.2 Validity of the authors' estimates of weekly consumption

Despite the great weight the authors place on their conclusions that numbers of cigarettes consumed in Australia increased after introduction of plain packaging, major questions can be raised about the validity and reliability of the data on cigarette consumption, both for Australia and for New Zealand.

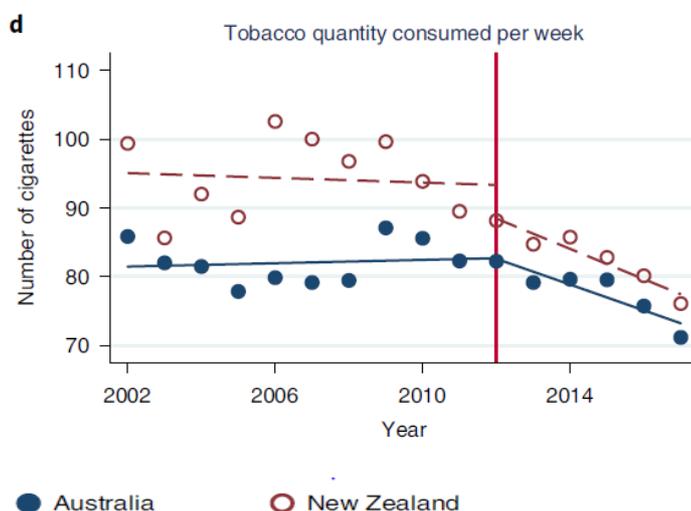
Suspiciously low estimates of weekly number of cigarettes in Australia

The authors estimate of weekly number of cigarettes consumed per smoker were collected from Australia's HILDA survey, a survey designed to examine changes over time in expenditure patterns across Australian society. Estimated numbers of cigarettes smoked are collected, but non-response rates are very high for the section of the survey in which this question is included. The authors do not report how they treat reported numbers of cigarettes in households with expenditure on tobacco but where survey respondents did not answer this question.

Australia's National Drug Strategy Household Survey has published estimates of consumption per smoker over a similar period, from 2001.

	2001	2004	2007	2010	2013	2016	2019
Per week	111.3	108.5	110.6	112	96.6	93.8	90.3

This shows weekly consumption declining from about 111 cigarettes per week in 2001 to 90 per week in 2019. The figures in the Underwood *et al* study however range from about 85 to 70, more than 20% lower. This major difference has not been explained and appears not to have been explored.



Lack of precision in the estimates

The HILDA surveys ask Australian smokers to convert roll-your-own (RYO) tobacco pouches (or other tobacco) purchased into an estimated number of cigarettes, with no instructions as to how they should go about doing this. This introduces a major source of imprecision which would have affected the Australian data to an increasing extent over time as the proportion of people using RYO tobacco increased – see below.

Lack of specificity to the nominated calendar year

HILDA data are collected over periods that span calendar years. So, for instance, in the 2011 wave, most of the responses were collected in 2011, however small but not trivial proportions were collected in 2012. The authors provide no detail as to how they treat the data collected from waves that were actually collected in the year after the main wave (and conceptually for the purposes of a study like this, belong to the following year).

Table 8.6: Fieldwork dates and percentage of interviews post December

Wave	Fieldwork period		Percentage of fieldwork post December	
	Beginning of fieldwork	End of fieldwork	Main Sample	Top-Up Sample
1	24 August 2001	23 January 2002	0.4	
2	21 August 2002	19 March 2003	2.3	
3	20 August 2003	9 March 2004	1.8	
4	19 August 2004	7 April 2005	2.3	
5	24 August 2005	14 March 2006	4.0	
6	23 August 2006	25 March 2007	2.2	
7	22 August 2007	18 February 2008	2.6	
8	20 August 2008	27 February 2009	3.0	
9	20 August 2009	11 March 2010	4.2	
10	17 August 2010	13 February 2011	3.7	
11	27 July 2011	19 February 2012	3.4	8.5
12	31 July 2012	10 February 2013	2.9	4.0
13	30 July 2013	9 February 2014	2.3	2.7
14	29 July 2014	8 February 2015	2.1	2.0
15	28 July 2015	7 February 2016	1.9	3.0
16	26 July 2016	5 February 2017	2.3	3.0
17	25 July 2017	4 February 2018	2.3	2.7
18	31 July 2018	10 February 2019	2.3	1.8

Lack of precision in the estimates due to sample variation

The study uses estimates of cigarette consumption that vary slightly from those reported by the HILDA survey investigators. The authors do not state the basis on which they made any adjustment of the data. They also do not report the confidence intervals around the estimates. The error margins around these figures are substantial: the standard deviations in most years are almost as large as the means.

Dataset: RP
Population: Smokers

Cross Wave Frequency (Summary Statistics)

SCQ:B3 Number of cigarettes usually smoked each week

File Type=RESPONDING PERSON FILE

Istbcn	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9
Mean		85	82	81	77	80	78	79	86
Std Dev		75	74	70	67	70	73	68	68
N Obs		2,863	2,681	2,555	2,528	2,392	2,316	2,200	2,206

<https://www.online.fbe.unimelb.edu.au/HILDAodd/KWCrossWaveCategoryDetails.aspx?varnt=Istbcn>

Lack of plausibility in the New Zealand estimates

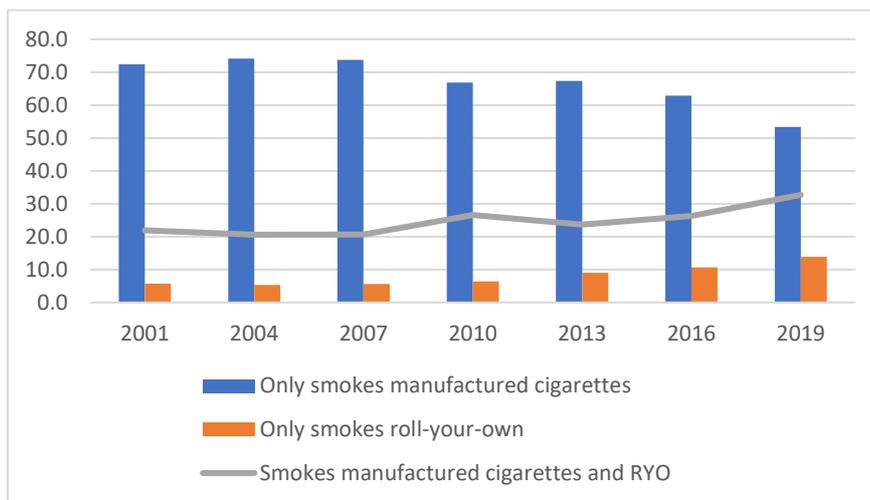
The wildly fluctuating estimates for New Zealand between 2002 and 2009 (and particularly the large increase between 2005 and 2006) and then the relatively small deviation from the trend after 2012 cast doubt on the validity of the authors' extremely crude method for estimating consumption in New Zealand.

3. Comparability between the two consumption estimates

The authors say that—in the absence of survey data on reported consumption in New Zealand—they estimated weekly consumption by dividing the estimated total of numbers of cigarettes purchased by the estimated number of smokers in the population ... a completely different method to the self-reported data used for the Australian estimate of cigarettes consumed per smoker. These two methods are subject to different limitations and could behave in different ways over time and particularly following tax increases.

The authors do not disclose how they defined a cigarette equivalent when they were looking at sales of RYO tobacco in New Zealand. If the authors assumed that every 100 grams of tobacco provided 100 cigarettes, then that would be a gross underestimation of the number of cigarettes smoked (given that studies on this topic reveal that smokers of RYO tobacco tend to roll cigarettes more like 0.5 grams (an amount that has decreased over time in both countries)).

A compounding problem is that more people have shifted to RYO tobacco in both countries over the period of this study. For instance, the proportion of smokers exclusively using RYO tobacco in Australia increased by 144% between 2001 and 2019. The proportion using both RYO tobacco and tailor-made cigarettes increased by 50%.



Current use(a) of manufactured cigarettes, roll-your-own cigarettes or a combination, current smokers aged 14 and over, 2001 to 2019 (col per cent)

Source: Table 2.17: Australian Institute of Health and Welfare. Data tables: National Drug Strategy Household Survey 2019 - 2. Tobacco smoking chapter, Supplementary data tables. Canberra: AIHW, 2020. Available from: <https://www.aihw.gov.au/reports/illicit-use-of-drugs/national-drug-strategy-household-survey-2019/data>.

If the authors did underestimate the number of RYO cigarette equivalents in New Zealand, then this would have become a source of increasing under-estimation over time of the number of cigarette equivalents smoked in New Zealand relative to Australia.

4. Conclusion about relative changes in cigarettes per week in Australia versus New Zealand

Given these major doubts about the accuracy of the 'cigarettes per week' measure in each of the countries, no conclusions can safely be drawn about either absolute levels of consumption or relative changes over time between the two countries.

If there were in reality any difference in the pattern of changes between countries, in 'number of cigarettes smoked each week' then—rather than being anything to do with plain packaging—this is much more likely to have been due to the differences in timing of the introduction of very large annual tax increases in each of the countries.