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David Thomas
Charles Darwin University

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National trends in Aboriginal and Torres Strait Islander smoking and quitting, 1994-2008

Abstract

Objective: To describe the trends in the prevalence of smoking, quitting and initiation among Aboriginal and Torres Strait Islander men and women aged 18 years and over.

Methods: Analysis of responses to smoking questions in national Indigenous surveys in 1994, 2002, 2004 and 2008.

Results: Male Indigenous smoking prevalence fell significantly from 58.5% in 1994 to 52.6% in 2008, an absolute decrease of 0.4 (CI 0.1-0.7)% per year, with the same decline in remote and non-remote areas. Female smoking fell from 51.0% to 47.4%, with markedly different changes in remote and non-remote areas. In non-remote areas, there was an absolute decrease in female smoking of 0.5 (CI 0.2-0.9)% per year, but in remote areas, female smoking increased by 0.4 (CI 0.0-0.8)% per year. From 2002 to 2008, the percentage of ever-smokers who had quit (quit ratio) increased absolutely by 1% per year in both men and women, remote and non-remote areas. Results about trends in initiation were inconclusive.

Conclusions and Implications: Health Minister Roxon has committed to halving the Indigenous smoking prevalence by 2018, and has dramatically increased Indigenous-specific funding and activity in tobacco control. The reported historical trends in this paper are encouraging as they occurred at a time when there was little such tobacco control activity focused on Aboriginal and Torres Strait Islander people. However, to meet the Minister's goal, Indigenous smoking prevalence will need to fall more than six times as quickly as occurred from 1994 to 2008.

Key words: Indigenous population, Australian Aborigines, smoking, tobacco, smoking cessation, trends

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David Thomas

Menzies School of Health Research & Lowitja Institute, Charles Darwin University, Northern Territory

Reducing Indigenous smoking is a central element of the Australian Government's efforts to 'Close the Gap' in health outcomes between Aboriginal and Torres Strait Islander people and other Australians. The Federal Minister for Health and Ageing, Nicola Roxon, has committed to halving the Indigenous smoking prevalence by 2018.¹ The age-standardised Indigenous prevalence of current smoking in 2008 was more than double that of other Australians (49.8% vs 20.5% of those aged 18 and over).² New Indigenous tobacco workers have been employed throughout the nation, an Indigenous social marketing campaign (including television advertisements) has been launched, and access to nicotine replacement therapy has been improved. This complements recent mainstream tobacco control public health policies that include the increase in the Federal tax excise in 2010, a national social marketing campaign, plans for plain packaging, and improved smokefree and retail display legislation in many jurisdictions.

In 2009, the myth that Indigenous smoking prevalence had been resiliently static while Australian smoking prevalence had been tumbling was busted.^{3,4} This work was based on comparisons of the first three national Indigenous surveys and of the second and fourth surveys. This paper examines the trends in smoking prevalence of Indigenous men and women aged 18 and over in all four national Indigenous surveys in 1994, 2002, 2004 and 2008 to better describe the historical trends in smoking prevalence and understand the challenge ahead. It also examines the trends in Indigenous smoking cessation and

initiation, which, together with the inevitable (and avoidable) increased death rate among smokers and ex-smokers, contribute to the trends in smoking prevalence.⁵

Methods

The National Aboriginal Torres Strait Islander Survey (NATSIS) was conducted from April to July 1994, the first National Aboriginal Torres Strait Islander Social Survey (NATSISS) from August 2002 to April 2003, the National Aboriginal Torres Strait Islander Health Survey (NATSISHS) from August 2004 to July 2005, and the second NATSISS from August 2008 to April 2009.^{4,6-8} All four surveys used multi-stage sampling strategies. The 1994 NATSIS sampled all residents from randomly selected households from a stratified sample of Census Collection Districts. The 2002 NATSISS and 2004 NATSIHS randomly sampled up to three residents from randomly selected households from either a stratified sample of Census Collection Districts or a random sample of discrete Indigenous communities and outstations. The 2008 NATSISS selected up to two residents aged 15 and over, and two aged under 15 years, from randomly selected households from either a stratified sample of Census Collection Districts, or one resident aged 15 and over and one child from randomly selected households from a random sample of discrete Indigenous communities and outstations. Non-private dwellings (e.g. hostels, hospitals, caravan parks and prisons) were only sampled in the first survey, but these were excluded from the file analysed in this

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Correspondence to: Assoc Professor David P Thomas, Menzies School of Health Research, PO Box 41096, Casuarina, Northern Territory 0811; e-mail: david.thomas@menzies.edu.au

paper.⁹ Response rates were about 80-90% in each survey.^{4,7,8,10}

Analyses used STATA Version 10 with the Confidentialised Unit Record Files (CURF) for each survey via ABS's Remote Data Laboratory. Under this arrangement, researchers do not have direct access to the datasets, but instead submit statistical code to Australian Bureau of Statistics (ABS), which returns the results to the researchers. All analyses used the expansion factor (or person weight) for each respondent to adjust for the disproportionate sampling of some groups, and so estimates reflect the total Indigenous population not just the sample.¹¹ These weights are based on the Indigenous estimated resident population in private dwellings on 30 June 1994, and 31 December 2002, 2004 and 2008.^{4,7-9} Standard errors and confidence intervals were calculated using the replicate weights for each person generated by ABS.¹¹

The annual change in prevalence between surveys was calculated by dividing the absolute change in prevalence by the number of years between the starting months of the two surveys being compared. The standard errors (and so confidence intervals) of the change in prevalences between surveys were calculated from the square root of the sum of the squares of the standard errors. The overall annual trend was also estimated by a linear regression model using the population prevalence estimate from each survey. This was estimated again with each of the datapoints weighted by the inverse of its variance, weights that reflect sampling variability. As there were only 100 replicate weights for the first survey and 250 for the

subsequent surveys, it would only be possible to combine the last three survey files to estimate trends and their standard errors using negative binomial regression models. Future surveys may again have different numbers of replicate weights, so regression models based on combined survey files are unlikely to be a particularly useful method of estimating trends and their standard errors.

The surveys differed in the smoking questions asked and how smoking was categorised (Table 1). The last two surveys also asked additional smoking questions not analysed in this paper.

The 2004 NATSIHS only asked people aged 18 and over about smoking, so this paper concentrates on this age group even though younger people were asked the question in other surveys. Variables for state or territory of Australia were not included in the CURF for the first survey, so the analyses using state or territory for this survey were performed separately by ABS using the original dataset. Results for Tasmania and ACT were combined in other CURFs; as this combination reflects no meaningful category, these results are not reported. Remote regions include those classified by the Australian Standard Geographical Classification (AGSC) as remote or very remote and include most of the continent: all of the arid inland and almost all of the tropical North.

There were 7,710 and 8,523 and 5,757 and 7,163 Indigenous people aged 18 and over who responded to the 1994, 2002, 2004 and 2008 surveys. Data on smoking status was missing for 10, 60, one and no respondents aged 18 and over in the four surveys.

Table 1: Smoking questions and definitions.

	1994 NATSIS	2002 NATSISS	2004 NATSIHS	2008 NATSISS
Questions	1. Do you smoke cigarettes (include packet and roll-your-own)? 2. How many cigarettes do you usually smoke a day?	In Remote Areas: 1. Do you smoke? 2. Do you have one smoke a day or more? 3. Have you ever smoked regularly, that is, one smoke a day or more? In Non-remote areas: 1. Do you currently smoke? 2. Do you smoke regularly, that is, one smoke a day or more? 3. Have you ever smoked regularly (that is, one smoke a day or more)?	1. Do you currently smoke? 2. Do you smoke regularly, that is, at least once a day? 3. Have you ever smoked regularly (that is at least once a day)? 4. Have you smoked at least 100 cigarettes in your entire life? 5. Have you smoked pipes, cigars or other tobacco products at least 20 times in your entire life? 6. How old were you when you first started to smoke regularly (that is at least once a day)?	1. Do you currently smoke? 2. Do you smoke regularly, that is, at least once a day? 3. Have you ever smoked regularly (that is, at least once a day)? 4. Have you smoked at least 100 cigarettes in your entire life? 5. Have you smoked pipes, cigars or other tobacco products at least 20 times in your entire life?
Current smoker	Yes to first question, or sometimes to first question and more than one to second question.	All daily and non-daily smokers.	All daily and non-daily smokers.	All daily and non-daily smokers.
Ex-smoker	–	Non-smokers who have previously smoked daily.	Non-smokers who have previously smoked daily or smoked at least 100 cigarettes in their lifetime or smoked pipes, cigars or other tobacco products at least 20 times in their entire lifetime.	Non-smokers who have previously smoked daily or smoked at least 100 cigarettes in their lifetime or smoked pipes, cigars or other tobacco products at least 20 times in their entire lifetime.
Never-smoker	–	Non-smokers who have never smoked daily.	Non-smokers who have never smoked daily or smoked at least 100 cigarettes in their lifetime or smoked pipes, cigars or other tobacco products at least 20 times in their entire lifetime.	Non-smokers who have never smoked daily or smoked at least 100 cigarettes in their lifetime or smoked pipes, cigars or other tobacco products at least 20 times in their entire lifetime.

NATSIS – National Aboriginal Torres Strait Islander Survey, NATSISS – National Aboriginal Torres Strait Islander Social Survey, NATSIHS – National Aboriginal Torres Strait Islander Health Survey.

These non-respondents were excluded in all calculations of smoking prevalence. Included separately are smoking prevalences of 893, 826 and 660 respondents aged 15-17 years in the 1994, 2002 and 2008 surveys.

Ethical approval was given by the Human Research Ethics Committee of the NT Department of Health and Families and Menzies School of Health Research, including its Aboriginal subcommittee.

Results

Male smoking prevalence fell significantly from 58.5% in 1994 to 52.6% in 2008, an absolute decrease of 0.4 (CI 0.1-0.7)% per year, with the same decline in remote and non-remote areas (see Table 2). Female smoking fell from 51.0% to 47.4%, with markedly different changes in remote and non-remote areas (Table 3). In non-remote areas, female smoking fell from 53.5 to 46.3% by 0.5 (CI 0.2-0.9)% per year. But in remote areas, female smoking increased from 45.0 to 50.4% by 0.4 (CI 0.0-0.8)% per year. The magnitude of the decreases in prevalence was greatest between the 2002 and 2004 surveys for men, and the 2004 and 2008 surveys for women. Apart from the significant increase in female smoking in the Northern Territory (NT) from 39.1 to 50.2%, smoking prevalence for men and women decreased in all jurisdictions from 1994 to 2008.

From 2002 to 2008, daily smoking prevalence fell significantly from 49.6 to 44.9% among non-remote women, but did not change among remote women (Table 5). There were smaller but similar non-statistically significant falls in daily smoking among remote and non-remote men (Table 4). There was little change in non-daily smoking prevalence.

Successful quitting increased in both men and women, and remote and non-remote areas from 2002 to 2008. The prevalence of ex-smokers increased significantly. The percentage of ever-smokers

who had quit (or quit ratio) increased significantly in men (23.2 to 29.3%) and women (24.2 to 30.8%).

In 2004, 70.4 (CI 68.4-72.4)% of Indigenous smokers started smoking before they were 18 years old and 96.1 (CI 95.3-96.9)% before they were 25 years old. From 2002 to 2008, the prevalence of ever having smoked at age 25-29 years increased in men from remote and non-remote areas and women from non-remote areas, but decreased in remote women, but none of these changes were statistically significant.

The two alternative regression-based methods of estimating trends gave very similar estimates, with no consistent differences between these two or from the estimates based on the difference between two survey results (weighted estimates in Tables 2-5 and un-weighted in Tables e1-e4 available at www.menzies.edu.au/research/preventable-chronic-disease/tobacco/ANZJPHeTables). Tables e1-e4 also describe the prevalence estimates for each category in Tables 2-5 for each survey, which are also available for the first three surveys elsewhere.³

Discussion

Prevalence trends

The results in this paper confirm recent reports and provide more detail about falling smoking prevalence among Indigenous men and women.^{3,4} As previously shown,³ the exception is the minimal change in smoking prevalence among remote Indigenous women, which is still consistent with remote Indigenous Australia being at an earlier phase in the predictable tobacco epidemic curve, at the flat peak of female smoking prevalence before female prevalence starts to fall.¹² The annual absolute decrease in smoking prevalence of 0.4% for Indigenous men is about half the fall among all Australian men, and the annual decline of 0.5% for non-remote Indigenous

Table 2: Trends in smoking prevalence (%) in Indigenous men aged 18+ years, 1994-2008.

	Prevalence	Annual change in prevalence between surveys			Regression-estimated annual change, 1994-2008	
	2008	1994-2002	2002-04	2004-08		
Age (years)						
15-17	20.5	0.2 (-1.0, 1.5)	na	na	-0.8 (-1.4, -0.1)*	-0.7 (-7.8, 6.4)
18-24	54.2	-0.0 (-1.3, 1.2)	-2.3 (-7.4, 2.8)	0.1 (-2.3, 2.5)	-0.3 (-1.0, 0.4)	-0.3 (-1.1, 0.4)
25-34	58.5	-0.9 (-1.9, 0.2)	-0.4 (-4.8, 4.1)	0.3 (-1.9, 2.5)	-0.5 (-1.1, 0.1)	-0.5 (-1.5, 0.5)
35-44	58.9	0.0 (-1.0, 1.1)	-0.6 (-4.7, 3.4)	-0.1 (-2.1, 2.0)	-0.1 (-0.7, 0.5)	-0.1 (-0.4, 0.2)
45-54	49.4	-0.1 (-1.3, 1.1)	-0.3 (-5.6, 5.0)	-0.5 (-3.1, 2.0)	-0.2 (-0.9, 0.5)	-0.2 (-0.6, 0.1)
55+	33.8	-0.1 (-2.1, 1.9)	-2.7 (-8.4, 3.0)	-0.6 (-3.1, 1.9)	-0.6 (-1.7, 0.5)	-0.7 (-2.0, 0.5)
Region						
Remote	59.2	-0.1 (-0.7, 0.4)	-1.1 (-4.0, 1.7)	-0.4 (-2.1, 1.2)	-0.4 (-0.8, 0.0)	-0.3 (-0.8, 0.2)
Non-remote	50.2	-0.4 (-1.1, 0.4)	-1.2 (-4.1, 1.7)	-0.0 (-1.4, 1.4)	-0.4 (-0.8, 0.0)	-0.4 (-0.8, 0.0)
Jurisdiction						
NSW	49.7	-0.4 (-1.8, 1.0)	-0.1 (-5.1, 5.0)	-0.8 (-3.2, 1.6)	-0.5 (-1.2, 0.3)	-0.5 (-0.8, -0.1)*
Victoria	49.5	-0.3 (-2.3, 1.7)	2.7 (-5.1, 10.4)	-2.0 (-5.5, 1.6)	-0.3 (-1.4, 0.7)	-0.4 (-1.7, 0.9)
Queensland	55.4	0.1 (-1.0, 1.2)	-2.9 (-7.3, 1.5)	0.7 (-1.6, 2.9)	-0.2 (-0.8, 0.5)	-0.2 (-1.5, 1.0)
SA	52.4	-1.6 (-3.0, -0.1)*	3.8 (-1.7, 9.4)	-1.7 (-4.6, 1.3)	-0.9 (-1.7, 0.0)	-0.8 (-3.1, 1.6)
WA	49.2	-0.6 (-1.6, 0.5)	-4.4 (-9.2, 0.5)	1.4 (-1.0, 3.8)	-0.5 (-1.1, 0.1)	-0.7 (-2.3, 0.9)
NT	60.0	-0.1 (-1.0, 0.9)	-0.6 (-5.2, 4.0)	-1.1 (-3.6, 1.4)	-0.4 (-1.1, 0.2)	-0.4 (-1.2, 0.4)
Total	52.6	-0.3 (-0.9, 0.2)	-1.2 (-3.4, 1.1)	-0.2 (-1.3, 0.9)	-0.4 (-0.7, -0.1)*	-0.4 (-0.7, -0.1)*

NSW – New South Wales, SA – South Australia, WA – Western Australia, NT- Northern Territory

*Statistically significant different from no change, $p < 0.05$.

Linear regression model estimates of slope (annual change) used the point estimates of prevalence from the four surveys, weighted by the inverse of the variance of each point estimate.

women is about the same as for all Australian women: current smoking prevalence fell from 29% to 21% in men and 23% to 18% among women aged 18 and over from 1995 to 2007.¹³ In the first six months following the launch of the National Tobacco Campaign in June 1997, and its intensive use of graphic television advertisements, smoking prevalence fell by 1.7% (22.0 vs 23.7%), however this rate of decline was not maintained in the following 12 months.¹⁴

In the US, another leading nation in reducing smoking, current smoking prevalence had an absolute annual decrease of 0.5% p.a. among both men and women aged 18 and over from 1992 to 2003, with larger falls among American Indian and Alaskan Native men (0.7%) and women (0.9%).¹⁵ Even California, with its world-leading tobacco control policies and well-funded public health campaigns, only had an absolute annual decline in smoking prevalence of 0.6% in non-Hispanic Whites (23.7 to 18.7%) and 0.9% in African Americans (28.4 to 20.7%) from 1992-93 to 2001-02.¹⁶ A decade of vigorous tobacco control policy advances in Minnesota after settlement of a lawsuit with the tobacco industry, including increased access to quitlines, mass-media campaigns, improved smoke-free legislation and cigarette tax rises, led to a fall in smoking prevalence from 22.1 to 16.1%, or an annual absolute decline of 0.5% in 1999-2010.¹⁷ Nevertheless, the relative (rather than absolute) reduction was much higher in all of these comparisons as the starting smoking prevalence was much lower in these populations than among Indigenous Australians.

Previous authors have noted that Australian smoking prevalence (aged 15 and over) fell twice as quickly after tobacco control activity increased with the start of the National Tobacco Control Campaign, from 0.34% p.a. (1991-95) to 0.66% p.a. (1998-2004).¹⁸ While there are no statistically significant trends in different time periods in our results, the only jurisdiction reporting an increasing trend in Indigenous smoking, among NT Indigenous women, has had the worst record on overall tobacco control in Australia. Every

year since 1994, the Australian Medical Association (AMA) and the Australian Council on Smoking & Health (ACOSH) have assessed overall tobacco control policies in the different states and territories, giving each jurisdiction a score out of a hundred based on ten criteria that have changed over time. They awarded the NT their Dirty Ashtray Award for the worst performing jurisdiction in nine of the fifteen years from 1994 to 2008, and omitted it from competition after it ranked last for the fourth consecutive year in 2009.¹⁹ The NT is also the jurisdiction with the largest proportion (79%) of Indigenous residents living in remote or very remote areas (compared with 25% of all Indigenous Australians).²⁰

Cessation trends

The most striking finding was the consistent increase in quitting from 2002 to 2008, in men and women and in remote and non-remote areas. This occurred in spite of few quit support services or campaigns focused on Indigenous people, apart from those provided in routine care by Aboriginal health services or other clinicians or as part of more general health promotion work. It is possible that changed Indigenous social norms around quitting and smoking have preceded the increase in Indigenous cessation support and quit campaigns that are now being provided. However, the Indigenous quit ratio is still low, there are less than half as many successful ex-smokers as current smokers, while in Australia overall there are now 30% more ex-smokers than smokers.²¹

Initiation trends

The story with initiation is more tempered. As in other settings, almost all initiation is complete by 25 years.²² The prevalence of ever-smoking at 25-29 years was used as a proxy for ever having started smoking, and displayed no significant trend from 2002 to 2008. As most of these 25-29 year olds would have started smoking up to a decade earlier, these trends may largely measure trends in

Table 3: Trends in smoking prevalence (%) in Indigenous women aged 18+ years, 1994-2008.

	Prevalence	Annual change in prevalence between surveys			Regression-estimated	
	2008	1994-2002	2002-04	2004-08	1994-2008	
Age						
15-17	23.8	0.5 (-0.7, 1.8)	na	na	-0.3 (-1.0, 0.5)	-0.2 (-6.4, 6.0)
18-24	51.8	0.5 (-0.6, 1.6)	-2.7 (-7.5, 2.2)	0.0 (-2.2, 2.3)	-0.1 (-0.6, 0.5)	-0.1 (-1.2, 1.0)
25-34	53.5	-0.4 (-1.2, 0.4)	-1.1 (-4.6, 2.3)	-0.4 (-2.1, 1.4)	-0.5 (-1.0, 0.0)*	-0.5 (-0.8, -0.2)*
35-44	48.1	0.2 (-0.8, 1.3)	1.8 (-1.9, 5.5)	-2.6 (-4.5, -0.8)*	-0.4 (-1.0, 0.3)	-0.3 (-2.8, 2.2)
45-54	46.7	0.1 (-1.1, 1.3)	2.9 (-1.8, 7.6)	-1.4 (-3.6, 0.8)	0.1 (-0.6, 0.7)	0.2 (-1.4, 1.7)
55+	30.9	0.7 (-0.6, 2.0)	-1.7 (-6.3, 2.8)	1.1 (-1.0, 3.1)	0.5 (-0.3, 1.2)	0.4 (-0.6, 1.4)
Region						
Remote	50.4	0.7 (-0.0, 1.4)	-0.6 (-3.8, 2.6)	0.2 (-1.3, 1.8)	0.4 (0.0, 0.8)	0.4 (-0.2, 1.0)
Non-remote	46.3	-0.2 (-0.8, 0.4)	-0.1 (-2.6, 2.5)	-1.3 (-2.5, -0.1)*	-0.5 (-0.9, -0.2)*	-0.5 (-1.3, 0.4)
Jurisdiction						
NSW	52.0	-0.2 (-1.3, 0.9)	-0.3 (-5.0, 4.4)	-0.5 (-2.7, 1.7)	-0.3 (-0.9, 0.3)	-0.3 (-0.6, -0.0)*
Victoria	49.8	-0.7 (-2.4, 0.9)	-6.3 (-12.8, 0.2)	0.7 (-2.4, 3.8)	-1.1 (-2.0, -0.2)*	-1.2 (-3.2, 0.8)
Queensland	40.9	-0.0 (-1.0, 0.9)	-0.2 (-4.0, 3.5)	-2.0 (-3.9, -0.1)*	-0.6 (-1.2, -0.1)*	-0.5 (-2.1, 1.1)
SA	50.4	-0.9 (-2.5, 0.7)	2.1 (-3.1, 7.4)	-0.6 (-2.9, 1.7)	-0.4 (-1.2, 0.5)	-0.3 (-1.6, 0.9)
WA	46.3	-0.1 (-1.3, 1.1)	1.8 (-2.9, 6.5)	-1.4 (-3.6, 0.8)	-0.2 (-0.8, 0.5)	-0.1 (-1.3, 1.1)
NT	50.2	1.5 (0.4, 2.6)*	-1.8 (-7.0, 3.4)	0.6 (-1.8, 3.0)	0.8 (0.2, 1.4)*	0.8 (-0.5, 2.1)
Total	47.4	0.1 (-0.4, 0.6)	-0.2 (-2.3, 1.8)	-0.9 (-1.9, 0.1)	-0.3 (-0.5, 0.0)	-0.2 (-1.0, 0.5)

* Statistically significant different from no change, $p < 0.05$.

Linear regression model estimates of slope (annual change) used the point estimates of prevalence from the four surveys, weighted by the inverse of the variance of each point estimate.

initiation a decade earlier. In contrast, more encouraging is the significant 0.8% p.a. absolute decrease in smoking prevalence among 15-17 year old boys and the more modest fall among same-aged girls. This is more consistent with results from school surveys, which have shown falling smoking prevalence among Indigenous 12 to 17 year olds from 1996 to 2005.²³

Methods and limitations

There are several common limitations with such self-reported survey data. There have been long-held concerns about the possibility of increasing under-reporting of smoking by self-report.^{24,25} However, the high prevalence of smoking among Indigenous people makes this increasing bias less likely, and a recent report found similar estimates of consumption in 22 remote

Table 4: Trends in prevalence (%) of smoking behaviours in Indigenous men aged 18+ years, 1994-2008.

	Prevalence	Annual change in prevalence between surveys		Regression-estimated	
	2008	2002-04	2004-08	annual change, 2002-08	
Total					
Daily smoker	49.9	-1.1 (-3.3, 1.2)	-0.3 (-1.4, 0.8)	-0.6 (-1.3, 0.1)	-0.6 (-2.7, 1.6)
Non-daily smoker	2.7	-0.1 (-0.7, 0.5)	0.2 (-0.1, 0.4)	0.1 (-0.1, 0.3)	0.1 (-0.8, 0.9)
Ex-smoker	21.8	1.7 (-0.0, 3.5)	0.4 (-0.6, 1.3)	0.8 (0.3, 1.4)*	0.8 (-3.0, 4.6)
Never smoke	25.6	-0.6 (-2.6, 1.4)	-0.2 (-1.1, 0.8)	-0.3 (-1.0, 0.3)	-0.3 (-1.5, 0.9)
Ever smoke (25-29 yrs)	76.4	2.0 (-4.1, 8.0)	1.3 (-1.6, 4.1)	1.5 (-0.3, 3.3)	1.4 (-0.5, 3.4)
Quit ratio	29.3	2.2 (-0.1, 4.5)	0.4 (-0.8, 1.6)	1.0 (0.3, 1.7)*	1.0 (-4.0, 5.9)
Remote					
Daily smoker	55.3	-1.0 (-3.8, 1.9)	-0.6 (-2.3, 1.0)	-0.8 (-1.7, 0.2)	-0.7 (-1.6, 0.1)
Non-daily smoker	3.9	-0.2 (-1.1, 0.8)	0.2 (-0.3, 0.7)	0.1 (-0.3, 0.4)	0.1 (-1.1, 1.3)
Ex-smoker	18.2	1.4 (-0.6, 3.3)	0.5 (-0.6, 1.6)	0.8 (0.2, 1.4)*	0.8 (-1.7, 3.3)
Never smoke	22.6	-0.2 (-2.8, 2.4)	-0.1 (-1.5, 1.3)	-0.1 (-0.9, 0.7)	-0.1 (-0.6, 0.4)
Ever smoke (25-29 yrs)	79.9	1.4 (-6.5, 9.4)	1.0 (-2.7, 4.6)	1.1 (-1.1, 3.4)	1.1 (-0.1, 2.3)
Quit ratio	23.5	1.7 (-0.8, 4.2)	0.6 (-0.8, 2.1)	1.0 (0.2, 1.8)*	1.0 (-2.3, 4.3)
Non-Remote					
Daily smoker	48.0	-1.1 (-4.1, 1.8)	-0.2 (-1.6, 1.2)	-0.5 (-1.4, 0.4)	-0.4 (-3.2, 2.3)
Non-daily smoker	2.3	-0.1 (-0.8, 0.6)	0.2 (-0.2, 0.5)	0.1 (-0.2, 0.3)	0.1 (-0.7, 0.9)
Ex-smoker	23.0	1.9 (-0.4, 4.2)	0.3 (-0.9, 1.5)	0.8 (0.1, 1.5)*	0.8 (-3.6, 5.1)
Never smoke	26.7	-0.7 (-3.2, 1.8)	-0.3 (-1.4, 0.9)	-0.4 (-1.2, 0.4)	-0.4 (-1.7, 0.9)
Ever smoke (25-29 yrs)	74.9	2.1 (-5.9, 10.1)	1.3 (-2.4, 5.1)	1.6 (-0.8, 4.0)	1.6 (-0.6, 3.8)
Quit ratio	31.4	2.4 (-0.7, 5.5)	0.3 (-1.3, 1.9)	1.0 (0.1, 1.9)*	0.9 (-4.8, 6.6)

* Statistically significant different from no change, $p < 0.05$.

Linear regression model estimates of slope (annual change) used the point estimates of prevalence from the three surveys, weighted by the inverse of the variance of each point estimate.

Table 5: Trends in prevalence (%) of smoking behaviours in Indigenous women aged 18+ years, 1994-2008.

	Prevalence	Annual change in prevalence between surveys		Regression-estimated	
	2008	2002-04	2004-08	annual change, 2002-08	
Total					
Daily smoker	45.7	-0.1 (-2.2, 1.9)	-0.8 (-1.8, 0.1)	-0.6 (-1.2, 0.1)	-0.6 (-2.7, 1.4)
Non-daily smoker	1.7	-0.1 (-0.8, 0.5)	-0.1 (-0.4, 0.2)	-0.1 (-0.3, 0.1)	-0.1 (-0.2, -0.0)*
Ex-smoker	21.1	1.3 (-0.1, 2.8)	0.5 (-0.2, 1.2)	0.8 (0.3, 1.2)*	0.7 (-1.7, 3.2)
Never smoke	31.6	-1.1 (-2.9, 0.7)	0.4 (-0.5, 1.3)	-0.1 (-0.7, 0.5)	0.0 (-4.8, 4.8)
Ever smoke (25-29 yrs)	72.5	0.1 (-4.3, 4.6)	0.3 (-2.0, 2.6)	0.2 (-1.3, 1.8)	0.3 (-0.3, 0.8)
Quit ratio	30.8	1.5 (-0.5, 3.6)	0.9 (-0.1, 1.9)	1.1 (0.5, 1.7)*	1.1 (-0.8, 2.9)
Remote					
Daily smoker	48.0	-0.7 (-3.8, 2.4)	0.3 (-1.3, 1.9)	0.0 (-1.0, 1.0)	0.0 (-2.9, 2.9)
Non-daily smoker	2.4	0.1 (-0.7, 0.9)	-0.1 (-0.5, 0.3)	0.0 (-0.3, 0.2)	0.0 (-0.6, 0.5)
Ex-smoker	15.2	2.3 (0.5, 4.0)*	-0.3 (-1.3, 0.7)	0.5 (0.1, 1.0)	0.5 (-5.8, 6.9)
Never smoke	34.4	-1.7 (-4.7, 1.4)	0.1 (-1.4, 1.6)	-0.5 (-1.5, 0.5)	-0.4 (-6.1, 5.2)
Ever smoke (25-29 yrs)	69.0	-0.4 (-6.9, 6.0)	-0.3 (-3.9, 3.2)	-0.4 (-2.5, 1.7)	-0.4 (-0.7, -0.1)*
Quit ratio	23.2	3.0 (0.3, 5.6)*	-0.5 (-1.9, 1.0)	0.7 (0.0, 1.4)	0.7 (-7.6, 8.9)
Non-Remote					
Daily smoker	44.9	0.1 (-2.4, 2.6)	-1.2 (-2.4, -0.1)*	-0.8 (-1.6, 0.0)*	-0.9 (-4.8, 3.0)
Non-daily smoker	1.5	-0.2 (-1.0, 0.6)	-0.1 (-0.4, 0.3)	-0.1 (-0.3, 0.1)	-0.1 (-0.4, 0.2)
Ex-smoker	23.1	1.0 (-0.8, 2.9)	0.7 (-0.2, 1.7)	0.8 (0.2, 1.4)*	0.8 (-0.0, 1.6)
Never smoke	30.6	-0.9 (-3.1, 1.2)	0.6 (-0.5, 1.6)	0.1 (-0.6, 0.8)	0.2 (-4.4, 4.7)
Ever smoke (25-29 yrs)	74.1	0.4 (-5.4, 6.1)	0.6 (-2.3, 3.5)	0.5 (-1.5, 2.5)	0.5 (-0.2, 1.2)
Quit ratio	33.3	1.1 (-1.5, 3.7)	1.3 (0.0, 2.6)*	1.2 (0.4, 2.0)*	1.2 (0.6, 1.9)*

* Statistically significant different from no change, $p < 0.05$.

Linear regression model estimates of slope (annual change) used the point estimates of prevalence from the three surveys, weighted by the inverse of the variance of each point estimate.

NT Aboriginal communities by self-report and store turnover.²⁶ The same questions were not asked in each survey, except the final two surveys. Compared to these two, in 1994, some non-daily smokers would not have been included as current smokers, and in 2002 some ex-smokers would have been called never smokers. The measured fall in current smoker prevalence in 1994-2002 and 1994-2008 may have been slightly too small, and the rise in ex-smokers and the quit ratio from 2002 to 2008 may have been slightly exaggerated. The data collection in the 1994 survey was completed much more quickly than in subsequent surveys, so using the starting month of data collection each survey as the date all surveys were completed (rather than the unavailable median date of collection for each survey) may have under-estimated the time between this survey and subsequent surveys, and so slightly over-estimated change 1994-2002 and 1994-2008.

The estimates conflate heterogeneity within jurisdictions or the remote/non-remote geographical regions. For example, all of the NT is classified as remote except for the capital Darwin and its immediate surrounds, but tobacco consumption in tropical Top End Aboriginal communities is more than double that in Central Australian communities.²⁶ Nevertheless, estimates of Indigenous smoking prevalence are much more accurate from these large Indigenous surveys than from the triennial National Drug Strategy Household Surveys, which are typically used to describe smoking trends but only include small Indigenous samples (372 in 2007).² Response rates remained high in all surveys.

It is reassuring that the alternative estimates of trends provided similar results. These methods will become more useful as the number of national Indigenous surveys increases, and have advantages as they are based on multiple datapoints not just two. Unlike others who have used models to predict future smoking prevalence, we have only presented historical trends in smoking prevalence, cessation and initiation; however our results could be used for prediction in such models.⁵

Conclusion

The challenge is large. For the Indigenous smoking prevalence to be halved in 10 years the male Indigenous smoking prevalence would need to fall by 2.6% p.a. and female prevalence by 2.4% (and the higher prevalence among remote Indigenous men by nearly 3%). These required rates of absolute decline are much larger than has occurred in other countries. We can be emboldened by the historical trends in this paper, especially as these occurred at a time when there was minimal investment in Indigenous-specific tobacco control. But to meet the Minister's challenge, smoking prevalence will need to fall more than six times as quickly as it did from 1994 to 2008, while smoking prevalence among the many Indigenous women who live in remote areas has yet to start falling.

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