Supporting Information

Supplementary methods and results

This appendix was part of the submitted manuscript and has been peer reviewed.
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Appendix to: Aw JYH, Heris C, Maddox R, et al. Who smokes in Australia? Cross-sectional analysis of Australian Bureau of Statistics survey data, 2017–19. *Med J Aust* 2024; doi: 10.5694/mja252216.

1. Supplementary methods: The Australian Bureau of Statistics National Health Survey and the National Aboriginal and Torres Strait Islander Survey

The Australian Bureau of Statistics (ABS) 2017–18 National Health Survey (NHS) was a nationally representative health survey conducted between July 2017 and June 2018 using a stratified multistage area sampling strategy. States and territories were divided into strata based on state statistical areas and socio-economic status. Each stratum contained base frame units that typically included 30-60 dwellings. Clusters containing 5-20 dwellings were selected by systematic skip within base frame units. In each dwelling, one adult (18 years or older) and one child (under 18 years) were randomly selected to participate in the survey (1).

The ABS 2018–19 National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) was a nationally representative health survey of Aboriginal and Torres Strait Islander people conducted between July 2018 and April 2019. Two samples were derived: a community sample and non-community sample. The community sample included a random selection of discrete Indigenous communities and associated outstations selected from the Dwelling Register for Aboriginal and Torres Strait Islander Communities. The non-community sample involved multistage area sampling of private dwellings outside Indigenous communities. Mesh blocks with Aboriginal or Torres Strait Islander households from the 2016 census were identified. Dwellings in each mesh block were randomly selected (total of 6,388 fully or adequately responding households in sample). For both community and non-community samples from non-remote areas, up to two adults (18 years or older) and two children (under 18 years) in each dwelling were randomly selected to participate. In remote areas, up to one adult and one child in each dwelling were randomly selected (2). The survey and weighting aimed for population representativeness of the sample in terms of geographic statistical areas and socio-economic status, not of sub-populations defined by health conditions.

We used nationally representative person-level weights derived by the ABS from the two surveys. These weights are the number of population units that the respective sample unit represents. Firstly, an initial household weight was calculated based on the inverse probability of selecting that household in the survey. Secondly, initial weights were assigned to participants providing complete responses based on the within-household sampling scheme described above. For adult participants, the corresponding household weight was multiplied by the number of adults in the household; for child participants, the household weight was multiplied by the number of children in the household. Person weights were calibrated to the estimated resident population living in private dwellings of non-very remote areas as well as demography benchmarks (state, age, sex, collapsed remoteness area) based on the population estimates for 31 December 2017 derived from the 2016 Census of Population and Housing: Australia (3). As the ABS quantitatively assessed the effect of non-response on population estimates and found it to be negligible, specific non-response adjustments were not made to these weights. For NATSIHS data, person-level weights were benchmarked to the estimated Aboriginal and Torres Strait Islander resident population living in private dwellings on 31 December 2018 (2).

2. Supplementary methods: data and variables

Smoking status

In the 2017–18 NHS and 2018–19 NATSIHS, smoking status was based on the following questions, which were the same in both surveys: “Do you currently smoke?”; “Do you smoke regularly, that is, at least once a day?; “Do you smoke at least once a week?”; If not currently smoking, “Have you ever smoked regularly, that is at least once a day?”; “Have you smoked at least 100 cigarettes in your entire life?”; Have you ever smoked pipes, cigars, or other tobacco products at least 20 times in your entire life?”

On the basis of responses to these questions, the ABS constructed the following categories: “Current daily smoker”, “Current weekly smoker”, “Other current smoker (less than weekly)”, “Ex-smoker” or “Never smoked”. Our main analysis used only “Current daily smoker”, “Ex-smoker” and “Never smoked”.

Socio-demographic variables

Sex was categorised as “Male” or “Female” and labelled as “men” and “women”, consistent with journal requirements. We defined seven age categories: 18–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75 years or older. Country of birth was dichotomised as “Born in Australia” or “Not born in Australia”. Main language spoken at home was dichotomised as “English” or “Not English”. Household composition was categorised as “Living with dependent children” (couple family with dependent children, one parent family with dependent children, multiple family households with dependent children), “Living with others but no dependent children” (couple only, other one family household, multiple family households with no dependent children, group household), and “Living alone”. Educational attainment was categorised as “Did not complete year 12” (including people who completed year 11, a not further defined certificate, or never attended school), “Completed year 12”, “Certificate I-IV/diploma/advanced diploma” and “Tertiary and above” (completed a bachelor, graduate diploma, graduate certificate or postgraduate degrees). Disability status was categorised according to ABS reporting: “Profound or severe core activity limitation”, “mild/moderate limitation or schooling/employment restriction”, “Has no disability or restrictive long-term health condition” (4).

Derived area-level variables

Socio-economic status was derived from the statistical area level 1 2016 Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) deciles, as recommended by the ABS (5). Remoteness was derived from the ABS 2016 Australian Statistical Geographic Standard for Remoteness (6). Employment status was categorised as “Working full-time”, “Working part-time”, “Unemployed looking for work”, “Not in labour force”.

Health variables

Health conditions were dichotomised as “yes” or “no” to ever having had the condition. When available, information on chronic diseases were derived from questions related to diagnosis by a doctor or nurse. Cancer status was based on responses to the question “Are you currently receiving treatment for cancer?” Asthma status was based on responses to the question “Have you had any symptoms of asthma or taken treatment for asthma in the past 12 months?” Diabetes status was based on responses to the question “At what age were you first told that you had high sugar levels?”. Osteoporosis and osteopenia status was based on responses to the question “At what age were you first told that you had osteoporosis/osteopenia?”. Cardiovascular disease, kidney disease, arthritis, other musculoskeletal and other lower respiratory condition status was based on responses to ABS comorbidity self-report variable questions. To be classified as having a condition, respondents needed to have reported being diagnosed with the condition and be experiencing the condition at the time of the survey (1)

Psychological distress was determined by responses to ten questions in the Kessler Psychological Distress Scale–10. Each questionnaire item was scored from 1 for “none of the time” to 5 for “all of the time”. An overall score of 10–15 indicated low, 16–21 moderate, 22–29 indicated high, and 30–50 very high psychological distress. Self-assessed health was assessed with a single question asking respondents to rate their overall health on a five-point scale from “excellent” to “poor”.

Intersectionality variables

When assessing intersectionality of remoteness and socio-economic status for Indigenous people, some categories were collapsed because of small cell numbers: For socio-economic status, quintiles 3 to 5 were grouped; for remoteness, inner and outer regional were grouped, as were remote and very remote.

3. Supplementary methods: Estimation of the numbers and proportions of Indigenous and non-Indigenous people aged 18 years or older by smoking category, and sensitivity analyses

This section summarises the methods used in estimating the proportion of people who smoke daily, who formerly smoked, or who have never smoked by Indigeneity, the rationale behind the method chosen, and sensitivity analyses examining the robustness of assumptions underlying these methods. The latter investigates hypothetical scenarios of change between 2017–18 and 2018–19 in the size of the total population and the population proportions for smoking status categories.

To estimate the numbers and crude proportions of Indigenous and non-Indigenous people in each smoking status category (Box 3), we used publicly available summary data: National Health Survey (NHS) 2017–18 data on the estimated number of people aged 18 years or older in each smoking status category (7), and National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) 2018–19 data on the estimated number of Indigenous people aged 18 years or older in each smoking status category (8). The estimated number of non-Indigenous people for each smoking status category was derived by subtracting the estimated number of Aboriginal and Torres Strait Islander people from the total population estimate. The estimated proportions of non-Indigenous and Aboriginal or Torres Strait Islander people who smoke daily were rounded (respectively to 92% and 8%) in the main article to avoid spurious precision.

Ideally, estimates of the numbers and proportions of Indigenous and non-Indigenous people by smoking status would be for the same time period. However, suitable smoking category estimates for the Indigenous population in 2017–18 and of the Australian population for 2018–19 are not available. The National Health Survey (2017–18) microdata do not include a flag to identify Aboriginal and Torres Strait Islander respondents. A non-Indigenous flag (NONINDST) is available to assist users extract non-Indigenous data. The guidance from the Australian Bureau of Statistics is that this Non-Indigenous flag should not be used to indirectly estimate numbers of Aboriginal and Torres Strait Islander people from NHS data, as the NHS does not include very remote areas of Australia and discrete Aboriginal and Torres Strait Islander communities (1). Accordingly, we did not use the Non-Indigenous flag from the NHS.

In sensitivity analyses, we examined the effect of more closely aligning the NHS data with data for the 2018–2019 financial year. We first considered likely annual changes in smoking status in the total population, based on time series analyses. Although NHS 2020–21 estimates are available (2,071,100 people who currently smoke; 5,280,400 people who formerly smoked; 11,888,500 people who never smoked) and could in principle facilitate estimation of annual changes in smoking status since 2017–18 (9), ABS guidance is that the data should be considered a break in time series from previous NHS collections and be used only for point-in-time national analyses (10). NHS 2020-21 data were collected during the COVID-19 pandemic; to maintain the safety of respondents and ABS interviewers, data were collected in online, self-completed forms. Non-response is usually reduced by interviewers following up households who have not responded; as this was not possible, the response rate was lower than usual, affecting representativeness for some sub-populations. In addition, ABS current smoking status estimates for the total population for 2020–21 combined data from NHS with other datasets, while ex-smoking is based on NHS data alone. The prevalence of daily and former smoking reported by ABS for 2020–21 were respectively 10.7% and 27.2%; the corresponding figures from the NHS 2017–18 were 13.8% and 29.2%. Comparisons of 2020–21 data and earlier smoking data were consequently not appropriate.

For these reasons, we used estimates from NHS 2017–18 and the NATSIHS 2018–19 in the main analysis, but conducted two sensitivity analyses, based on alternative scenarios: (1) population growth of 1.5% from 2017–18 to 2018-19; and (2) the population growth and a one percentage point drop per year in daily smoking and 0.7 percentage point drop in ex-smoking between the two periods (Table 6).

Table 1. Country of birth–sex characteristics (combined category) of people who smoke daily, formerly smoked, or have never smoked, Australia, based on 2017–18 survey data*

	Weighted proportion (95% confidence interval)		
Sex/country of birth	Smoke daily	Formerly smoked	Never smoked
Men born in Australia	40.4% (37.7–43.1%)	36.9% (35.3–38.6%)	28.6% (27.3–29.9%)
Women born in Australia	32.1% (29.7–34.6%)	32.0% (30.4–33.5%)	35.5% (34.2–36.8%)
Men not born in Australia	18.4% (16.4–20.7%)	19.7% (18.3–21.1%)	13.5% (12.6–14.5%)
Women not born in Australia	9.1% (7.8–10.6%)	11.4% (10.4–12.5%)	22.4% (21.2–23.5%)

* Derived from Australian Bureau of Statistics 2017–18 National Health Survey data (respondents: 2453 people who smoke daily, 5384 who formerly smoked, and 8319 who have never smoked); proportions weighted at the person level (11).

Table 2. Postcode-based remoteness–socio-economic characteristics (combined category) of non-Indigenous people who smoke daily, formerly smoked, or have never smoked, Australia, based on 2017–18 survey data *

	Weighted proportion (95% confidence interval)		
Characteristic	Smoke daily	Formerly smoked	Never smoked
Total number			
Major city			
Quintile 1 (most disadvantaged)	14.0% (12.2–16.0%)	8.9% (8.0–9.9%)	10.0% (9.2–10.9%)
Quintile 2	16.4% (14.4–18.7%)	11.7% (10.7–12.8%)	12.4% (11.5–13.4%)
Quintile 3	14.5% (12.7–16.6%)	14% (12.9–15.3%)	15.6% (14.6–16.6%)
Quintile 4	11.9% (10.2–13.7%)	15.7% (14.5–17%)	17.8% (16.8–18.9%)
Quintile 5 (least disadvantaged)	10.0% (8.2–12.1%)	19.1% (17.7–20.5%)	21.2% (20.0–22.4%)
Inner and outer regional			
Quintile 1 (most disadvantaged)	8.3% (6.9–9.9%)	4.6% (4.0–5.3%)	3.6% (3.1–4.1%)
Quintile 2	7.0% (5.6–8.6%)	6.4% (5.6–7.2%)	3.9% (3.4–4.4%)
Quintile 3	3.3% (2.4–4.6%)	3.8% (3.2–4.4%)	3.5% (3.0–4.0%)
Quintile 4	2.2% (1.5–3.2%)	3.9% (3.3–4.7%)	3.1% (2.6–3.6%)
Quintile 5 (least disadvantaged)	0.4% (0.2–0.8%)	1.5% (1.2–2.0%)	1.5% (1.2–1.9%)
Remote and very remote			
Quintile 1 (most disadvantaged)	5.0% (4–6.2%)	3.0% (2.5–3.5%)	1.7% (1.5–2.1%)
Quintile 2	2.6% (2–3.4%)	3.1% (2.6–3.7%)	2.5% (2.1–2.9%)
Quintile 3	3.2% (2.4–4.2%)	2.3% (1.9–2.9%)	1.8% (1.5–2.1%)
Quintile 4	0.9% (0.6–1.3%)	1.6% (1.2–2%)	1.2% (1.0–1.5%)
Quintile 5 (least disadvantaged)	0.3% (0.2–0.7%)	0.5% (0.4–0.8%)	0.4% (0.3–0.6%)

* Derived from Australian Bureau of Statistics 2017–18 National Health Survey data (respondents: 2265 people who smoke daily, 5269 who formerly smoked, and 8186 have who never smoked); proportions weighted at the person level (11).

Table 3. Demographic characteristics of people who currently smoke (daily, weekly or less than weekly) or smoke daily, Australia, based on 2017–18 survey data: sensitivity analysis*

	Weighted proportion (95% confidence interval)	
Characteristic	Currently smoke†	Smoke daily
Sex		
Men	58.9% (56.4–61.4%)	58.8% (56.2–61.4%)
Women	41.1% (38.6–43.6%)	41.2% (38.6–43.8%)
Age group (years)		
18–24	13.1% (11.2–15.4%)	12.2% (10.2–14.5%)
25–34	21.8% (19.6–24.2%)	20.7% (18.4–23.2%)
35–44	19.6% (17.7–21.6%)	20.0% (18.1–22.2%)
45–54	20% (18.1–22.1%)	20.6% (18.6–22.9%)
55–64	16.1% (14.5–17.8%)	16.6% (14.9–18.5%)
65–74	6.5% (5.6–7.7%)	6.8% (5.8–8.1%)
75 or older	2.9% (2.2–3.7%)	2.9% (2.3–3.8%)
Country of birth		
Australia	72.1% (69.7–74.3%)	72.5% (70.0–74.8%)
Other	27.9% (25.7–30.3%)	27.5% (25.2–30.0%)
Main language		
English	89.8% (87.9–91.4%)	90.3% (88.4–92.0%)
Not English	10.2% (8.6–12.1%)	9.7% (8.0–11.6%)
Socio-economic status‡		
Quintile 1 (most disadvantaged)	27.1% (25–29.4%)	28.5% (26.2–30.9%)
Quintile 2	25.4% (23.3–27.8%)	25.8% (23.5–28.3%)
Quintile 3	20.9% (18.8–23.1%)	20.4% (18.3–22.7%)
Quintile 4	15.0% (13.3–16.8%)	14.8% (13.1–16.8%)
Quintile 5 (least disadvantaged)	11.6% (9.8–13.6%)	10.4% (8.7–12.5%)
Remoteness§		
Major city	66.4% (64–68.7%)	65.4% (62.8–67.8%)
Inner regional	21.1% (19.1–23.3%)	21.3% (19.2–23.7%)
Outer regional/remote	12.5% (11.1–14.1%)	13.3% (11.7–15.0%)
Household composition		
Living with dependent children	34.7% (32.2–37.2%)	34.6% (32.1–37.3%)
Living with others, but not dependent children	45.6% (43–48.2%)	44.9% (42.2–47.7%)
Living alone	19.7% (18.2–21.3%)	20.5% (18.8–22.2%)
Highest educational attainment¶		
Did not complete year 12	29.2% (26.7–31.8%)	31.0% (28.3–33.9%)
Completed year 12	14.0% (12.1–16.2%)	13.6% (11.6–15.8%)
Trade certificate/diploma	41.5% (38.6–44.4%)	42.1% (39.1–45.2%)
Tertiary degree	15.3% (13.3–17.6%)	13.3% (11.4–15.6%)
Employment status¶		
Working full-time	50.2% (47.3–53.1%)	49.1% (46.1–52.2%)
Working part-time	19.6% (17.4–21.9%)	19.4% (17.1–21.9%)
Unemployed, looking for work	5.2% (4.1–6.8%)	5.4% (4.1–6.9%)
Unemployed, not looking for work	25.0% (22.7–27.5%)	26.1% (23.6–28.7%)
Disability status		
Profound or severe core activity limitation	5.2% (4.3–6.3%)	5.4% (4.4–6.6%)
Other limitation**	25.8% (23.7–28.1%)	27.0% (24.7–29.4%)
Has no disability or restrictive long-term health condition	69.0% (66.6–71.2%)	67.6% (65.1–70.0%)

* Derived from Australian Bureau of Statistics 2017–18 National Health Survey data (respondents: 2667 people who currently smoke, of whom 2453 smoke daily); proportions weighted at the person level (11).
† Currently smokes": smokes daily, weekly, or less than weekly.
‡ Australian Bureau of Statistics 2016 Index of Relative Socioeconomic Advantage and Disadvantage at the Statistical Area 1 level (12).
§ Australian Bureau of Statistics 2016 Australian Statistical Geographic Standard for remoteness (13).
¶ Includes only survey respondents aged 25–64 years (working age).
** Mild or moderate limitation, or limitation affecting education or employment.

Table 4. Postcode-based residential characteristics of Aboriginal and Torres Strait Islander people who currently smoke (daily, weekly or less than weekly) or smoke daily, Australia, based on 2018–19 survey data: sensitivity analysis*

	Weighted proportion (95% confidence interval)	
Remoteness‡/socio-economic status§	Currently smoke†	Smoke daily
All people who smoke		
Major city		
Quintile 1 (most disadvantaged)	12.5% (10.6–14.7%)	12.9% (11.0–15.2%)
Quintile 2	5.6% (4.2–7.4%)	5.6% (4.1–7.5%)
Quintiles 3 to 5 (least disadvantaged)	9.9% (7.5–12.8%)	10.1% (7.7–13.2%)
Inner and outer regional		
Quintile 1 (most disadvantaged)	31.3% (28.4–34.3%)	32.6% (29.6–35.8%)
Quintile 2	8.9% (7.1–11.2%)	8.4% (6.6–10.6%)
Quintiles 3 to 5 (least disadvantaged)	5.4% (4.0–7.3%)	5.2% (3.8–7.1%)
Remote and very remote		
Quintile 1 (most disadvantaged)	21.7% (19.9–23.7%)	20.4% (18.5–22.4%)
Quintile 2	3.0% (2.4–3.7%)	3.0% (2.4–3.7%)
Quintiles 3 to 5 (least disadvantaged)	1.7% (1.3–2.3%)	1.7% (1.3–2.3%)

* Derived from Australian Bureau of Statistics Australian Bureau of Statistics 2018–19 National Aboriginal and Torres Strait Islander Health Survey data (respondents: 3028 people who currently smoke, of which 2808 smoke daily); proportions weighted at the person level (14).
† Smokes daily, weekly, or less than weekly.
‡ Australian Bureau of Statistics 2016 Australian Statistical Geographic Standard for remoteness (13).
§ Australian Bureau of Statistics 2016 Index of Relative Socioeconomic Advantage and Disadvantage at the Statistical Area 1 level (12).

Table 5. Estimated numbers and proportions of Aboriginal and Torres Strait Islander people and non-Indigenous people aged 18 years or more who currently smoke (daily, weekly, or less than weekly) or smoke daily, Australia, based on 2017–18 and 2018–19 survey data: sensitivity analysis*

Population	Currently smoke†	Currently smoke daily
Aboriginal and Torres Strait Islander people	210,900 (7.5%)	195,700 (7.6%)
Non-Indigenous people	2,613,900 (92.5%)	2,371,300 (92.4%)

* Derived from Australian Bureau of Statistics 2017–18 National Health Survey(11) and 2018–19 National Aboriginal and Torres Strait Islander Health Survey data (14).
† Smokes daily, weekly, or less than weekly.

Table 6. Estimated numbers and proportions of Aboriginal or Torres Strait Islander people and non-Indigenous people aged 18 years or more, based on 2017–18 and 2018–19 survey data, by smoking status: sensitivity analyses*

Population	Smoke daily	Formerly smoked	Never smoked
Main analysis (= Box 7 in main article)			
All people (NHS, 2017–18)*	2,567,000	5,440,800	10,388,100
Aboriginal or Torres Strait Islander people (NATSIHS, 2018–19)†	195,700 (8%)	116,700 (2%)	159,000 (2%)
Non-Indigenous people (derived)‡	2,371,300 (92%)	5,324,100 (98%)	10,229,100 (98%)
Sensitivity analysis 1			
Assumptions: *1) 1.5% increase in total population from 2017–18.* *2) Proportions by smoking status as in 2017–18.*			
All people	2,605,505	5,522,412	10,543,922
Aboriginal or Torres Strait Islander people (NATSIHS, 2018–19)†	195,700 (8%)	116,700 (2%)	159,000 (2%)
Non-Indigenous people (derived)‡	2,409,805 (92%)	5,405,712 (98%)	10,384,922 (98%)
Sensitivity analysis 2			
Assumptions: *1) 1.5% increase in total population from 2017–18.* *2) Proportion of people who smoke daily one percentage point smaller and of people who formerly smoked by 0.7 percentage point smaller in 2018–19 than in 2017–18.*			
All people	2,418,787	5,391,709	10,861,343
Aboriginal or Torres Strait Islander people (NATSIHS, 2018–19)†	195,700 (8%)	116,700 (2%)	159,000 (2%)
Non-Indigenous people (derived)‡	2,223,087 (92%)	5,275,009 (98%)	10,702,343 (98%)

* Derived from Australian Bureau of Statistics 2017–18 National Health Survey (NHS) summary data on estimated number of people aged 18 years and over for the reference period of 2017-18 financial year (6).

† Derived from Australian Bureau of Statistics 2018–19 National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) summary data on estimated number of people aged 18 years and over for the reference period of 2018-19 financial year (7).

‡ Derived by deduction of the Aboriginal and Torres Strait Islander population estimate from the total population estimate.

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