Changing patterns and prevalence of daily tobacco smoking among Australian workers: 2007–2016

Ann Roche,[1] Alice McEntee,[1] Susan Kim,[1] Janine Chapman[1]

Abstract

Objective: To map patterns and prevalence of daily smoking among employed Australians over time.

Methods: Data from four waves of the triennial National Drug Strategy Household Survey (2007, 2010, 2013 and 2016) were used to assess daily smoking. Frequency analyses and significance testing examined smoking prevalence by sex, age, state, remoteness, Indigeneity, socioeconomic status (SES) and psychological distress. Logistic regression models estimated adjusted effects of demographics on smoking prevalence.

Results: Workers' daily smoking prevalence reduced by 32% between 2007 and 2016. The adjusted model showed the lowest smoking reductions among men and non-metropolitan workers. Other interaction effects showed the highest daily smoking rates for: male workers aged 14–39 years; low SES non-metropolitan workers; and low SES workers aged 40–59 years.

Conclusions: Specific workplace policies, prevention and intervention strategies are warranted for male workers, especially those aged 14–39; non-metropolitan workers, especially low SES rural workers; and low SES workers especially 40–59-year-olds.

Implications for public health: In spite of significant smoking reductions among workers over time, reductions were unevenly distributed. Tailored, innovative workplace prevention and intervention strategies that apply principles of proportionate universalism and address individual, workplace settings and cultural factors are warranted to reduce smoking disparities among male, rural and low SES workers.

Key words: daily tobacco smoking, workers, demographics, trends over time

Tobacco use is a risk factor for chronic diseases and the leading preventable cause of premature death.[1,2] It was responsible for 9.3% of Australia's total burden of disease in 2015[1] (the highest of any risk factor), 13% of all deaths and 5% of chronic disease, and is associated with cancer, cardiovascular disease and respiratory diseases. Although the tobacco-related burden of disease predominately affects current or past smokers, non-smokers are also at risk of ill-health due to secondhand smoke exposure,[1] with important implications for workers and workplaces.

Between 1991 and 2016, smoking prevalence in Australia decreased from 29.5% to 14.9%,[3] with declines attributed to higher abstinence rates (49.0% in 1991 vs. 62.3% in 2016).[3,4] Increased abstinence decreased the associated fatality burden, with non-smokers' life expectancy 10–11 years greater than long-term smokers'.[5] Premature mortality and morbidity among smokers impacts Australian workplaces and productivity.

Tobacco smoking prevalence varies by population group,[2] reflecting social, economic, psychological and cultural factors,[1,6] with highest levels in lowest socioeconomic status (SES), income, occupation and education groups.[2,6,7] While smoking prevalence is higher among the unemployed (22.8%) and those unable to work (30.1%),[4] numerically the largest number of smokers is found among those in the paid workforce[8] underlining the importance of targeting this group. There is also a significant but under-explored variation among those who are employed. It is unclear how smoking patterns precisely vary across Australia's workforce.

A better understanding of smoking prevalence and patterns can inform targeted interventions and reduce associated costs. Smoking incurs a substantial cost to the business sector due to factors that include poorer health and more absenteeism among workers who smoke. There is also an increased cost to workplaces from smoking-related injuries and accidents. In 2015–16, tobacco smoking in Australia cost $137 billion,[9] with costs to workplaces estimated at $5 billion.[10] These costs were largely attributed to the 11.3 billion days of excess absenteeism from smokers' ill health (above the absences of non-smokers).[10] In 2016, the total cost of smoking-related lost productivity was estimated at $388 billion over the working life of the Australian population.[11]

The workplace provides a unique, but largely under-utilised, setting in which to implement smoking cessation strategies. It is important to identify the socio-demographic characteristics of workers who smoke so that available intervention opportunities and resources are used judiciously to help address smoking trends that have slowed or plateaued among some groups.

The workplace plays an important contributory role in the uptake and continuance of smoking.[12] It has been pivotal in implementing behaviour change strategies

1. National Centre for Education and Training on Addiction, Flinders University, South Australia
Correspondence to: Professor Ann Roche, National Centre for Education and Training on Addiction, Flinders University, GPO Box 2100, Adelaide 5001 SA; e-mail: ann.roche@flinders.edu.au
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and smoking cessation policies, including smoke-free workplaces.[13-17] Examining patterns and prevalence of daily smokers within the employed population is important. While there is strong evidence regarding the socio-demographic factors associated with smoking, comparatively limited examination of patterns and prevalence of daily smoking has been undertaken of employed Australians. The present study aimed to examine the following research questions:

1. Has daily smoking prevalence among employed Australians changed over time?
2. Has daily smoking prevalence among employed Australians changed over time by demographic and mental health factors (age, sex, state, remoteness, Aboriginal and Torres Strait Islander [referred to as Indigenous hereon for brevity] identity, SES and psychological distress)?

Methods

Data source

Data from four waves (2007,[18] 2010,[19] 2013,[20] and 2016[8]) of the National Drug Strategy Household Survey (NDSHS) were used. The NDSHS is a triennial cross-sectional nationally representative survey of Australian's attitudes, opinions and behaviour regarding tobacco, alcohol and illicit drug use. The NDSHS uses multi-stage stratified sampling techniques and is weighted within geographic strata by household size, age and sex to be representative of the total population.[4]

Data from 49,395 (weighted N=39,428,968) employed participants aged 14 years and older across the four survey years were analysed. Of the pooled sample, 23.9% (weighted N=9,322,044); 27.5% (weighted N=9,665,418); 24.7% (weighted N=10,003,648); and 23.9% (weighted N=10,437,858) of participants were from 2007, 2010, 2013 and 2016, respectively. Across the four surveys response rates ranged from 49.1% to 51.1%.

Measures

Employment status was determined via the question: "Which of the following best describes your main current employment status?" Only respondents who selected "self employed" or "employed for wages, salary or payment in kind" were included in the analysis. Wording and response options for this question differed in 2007 as the term 'main' and response option "self employed" were not included.

The variable 'TobSum' (summary of tobacco use) was used to identify smoking status. The Australian Institute of Health and Welfare (AIHW) used six questions to derive the TobSum variable. Respondents were categorised as 'daily smoker', 'occasional smoker' (weekly or less than weekly), and 'ex-/never smoker'. Identical question wording was used across the survey years. Daily smoking was selected as the tobacco use measure, given its association with greater harm and prevention challenges.

Demographic variables of interest were sex (male; female), age (14–24; 25–39; 40–59; 60+), state of residence, remoteness (metropolitan; non-metropolitan), Indigeneity (Indigenous; non-Indigenous), and SES (low [1st and 2nd quintile]; high [3rd-5th quintile][21]). Remoteness categories were based on the Australian Bureau of Statistics' (ABS) 2011 Australian Statistical Geography Standard. Areas were classified according to their distance from five population centre types and dichotomised as metropolitan (major cities) and non-metropolitan (inner regional, outer regional, remote and very remote). The five SES quintiles were based on the ABS Index of Relative Socio-Economic Advantage and Disadvantage.[4,21] Low SES here represents the 40% of areas with the greatest overall level of disadvantage and high SES the 60% of areas with the greatest overall level of advantage. Psychological distress was assessed via Kessler's 10-item (K10) scale (e.g. "In the past 4 weeks, about how often did you feel nervous") using a 5-point scale (1: "none of the time" – 5: "all of the time"). Total scores ranged from 10 to 50, with higher scores indicating higher psychological distress. K10 scores were categorised according to ABS procedures as low: 10–15; moderate: 16–21; high: 22–29; and very high: 30–50.[22,23]

Question wording was consistent across waves for age, Indigenous identity and psychological distress, but varied for sex. The 2007–2013 question: "Are you male or female?" (yes, no) was reworded in 2016 as: "What is your sex?" (male, female, other). Although 23 respondents selected 'other', they were excluded from the Confidentialised Unit Record File (CURF) dataset for confidentiality reasons.[24] State, remoteness and SES quintile ranges were based on the location of the household sampled.

Slight variations in wording for employment status and sex is unlikely to influence the study's findings. AIHW investigates the impact of word changes on time series analyses and reported no issues for these variables.

Analysis

The statistical software package STATA (version IC 15)[25] was used to analyse the data. The four NDSHS datasets were combined into one data file. Survey responses were weighted to the appropriate Australian population for each survey year using the absolute person weightings available in the corresponding dataset. Frequency analyses and significance testing ($p \leq 0.05$) explored differences in daily smoking prevalence across key demographic variables over time.

Multivariable logistic regression models examined the relationships between the significant demographic variables (including K10) and daily smoking prevalence over time. A forward stepwise procedure was undertaken to build a multivariable logistic regression model to examine these relationships with only significant variables ($p \leq 0.05$) included in the final model. First, we included survey year and seven significant demographic variables in the model (Model 1, Supplementary Table 1). Second, we examined all potential interaction terms between survey year and the demographic variables (added to Model 1) to examine whether the change in smoking prevalence over time differed between demographic groups. Two interaction terms (survey year and sex; survey year and remoteness) that were significant after adjusting for all other variables remained in the model (Model 2, Supplementary Table 2). Third, we examined interaction terms among the seven demographic variables that were added to Model 2. Three interaction terms (age and sex; age and SES; remoteness and SES) were also significant and included in the final model (see Supplementary Table 3). The final model included five interactions (survey year and sex; survey year and remoteness; age and sex; age and SES; remoteness and SES), see Figure 2. All interactions were treated as multiplicative and only true interactions, not effect modifications, were included in the analyses.[26]

Results

Demographic profile of employed Australians

Between 2007 and 2016, employed Australians were significantly more likely to

be male (55.7%), aged 40–49 years (44.8%), identify as non-Indigenous (98.5%), live in New South Wales (31.4%), reside in a metropolitan location (70.1%), have high SES (66.9%), have low psychological distress (70.6%) and be a non-smoker (81.4%), see Table 1.

Daily smoking prevalence over time

Daily smoking among employed Australians declined significantly between 2007 and 2016 (Table 1). Prevalence levels declined in each consecutive three-year period resulting in a 32% reduction overall.

Demographic differences

Age

For all age groups, daily smoking prevalence generally declined over time (Figure 1, Table 2). Prevalence in 2007 varied from 10.9% to 20.9% across age groups. Workers aged 25–39 years were twice as likely to smoke as workers aged 60+ years. By 2016, prevalence levels varied less by age (8.8%–13.1%), differing by 0.1%–0.4% among those under 60 (Table 2). After adjusting for other variables in the first logistic regression model, there was no significant difference in prevalence by age and year (p=0.099, Figure 1).

Sex

Daily smoking prevalence among employed males and females declined over time. Prevalence was higher for males than females in each survey year (Figure 1). Over time, smoking levels reduced by 38% for females and 27% for males. This relationship remained significant after adjusting for other variables (Table 2). The final logistic regression model (Supplementary Table 3, and see Figure 2 for graphical displays of all significant interaction terms included in the final model) shows prevalence was higher among employed males than females in all years, but with a steeper decrease for females over time (p=0.031, Figure 2).

State

Among employed Australians, daily smoking prevalence generally decreased over time across all states/territories (Figure 1). Tasmania had the largest decrease with a 41% reduction in prevalence between 2007 and 2016 (27.0% to 16.1%) (Table 2). Overall, however, state of residence did not significantly affect the decline in prevalence over time.

Table 1: Demographic profile and tobacco smoking status of employed Australians over time.

Demographics	Employed %				
	2007	2010	2013	2016	2007-2016
Sample size[a]	11,789	13,590	12,221	11,795	49,395
Sex**					
Male	56.5	56.2	56.3	54.0	55.7
Female	43.5	43.8	43.8	46.0	44.3
Age groups**					
14-24 years	14.1	13.3	12.4	11.6	12.8
25-39 years	33.4	34.0	34.0	35.0	34.1
40-59 years	45.2	45.2	45.1	44.0	44.8
60+ years	7.3	7.5	8.5	9.5	8.2
Aboriginal and/or Torres Strait Islander**					
Yes	1.0	1.3	1.5	2.2	1.5
No	99.0	98.7	95.5	97.8	98.5
State**					
New South Wales	31.7	31.8	30.4	31.7	31.4
Victoria	24.9	24.5	25.2	25.8	25.1
Queensland	20.6	20.6	20.4	19.7	20.3
Western Australia	10.3	10.8	11.4	11.0	10.9
South Australia	7.4	7.0	7.2	6.7	7.1
Tasmania	2.1	2.2	2.2	2.0	2.1
Australian Capital Territory	1.9	2.0	1.9	1.9	1.9
Northern Territory	1.1	1.2	1.3	1.3	1.2
Remoteness**					
Metropolitan	68.7	69.0	71.3	71.2	70.1
Non-metropolitan	31.3	31.0	28.7	28.8	29.9
Socioeconomic status[b]**					
Low	31.0	33.0	32.7	35.6	33.1
High	69.0	67.0	67.3	64.4	66.9
Psychological distress[c]**					
Low	70.9	71.6	71.2	68.7	70.6
Moderate	21.1	20.3	20.5	21.3	20.8
High	6.6	6.5	6.4	7.7	6.8
Very high	1.3	1.6	2.0	2.3	1.8
Smoking status					
Frequency**					
Current daily[d]	18.5	16.1	13.5	12.5	15.1
Current occasional	3.3	3.5	3.7	3.5	3.5
Non-smoker/Ex-Smoker	78.3	80.4	82.7	84.0	81.4

Notes:

Source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007, 2010, 2013, 2016: Confidentialised unit record file. Canberra: Available from the Australian Data Archive; 2017.

a: Reported n's are unweighted however the proportions are based on weighted n's.

b: Groups based on quintile range: Low SES = 1st and 2nd quintile; High SES = 3rd-5th quintile.

c: Groups based on how respondents scored on the psychological distress scale: Low = 10-15; Moderate = 16-21; High = 22-29; Very high = 30-50.

d: Group differences significant at p<0.01. P-value based on 2007 and 2016 difference in daily smoking prevalence.

*** Group differences significant at p<0.01. P-value based on pooled group differences for 2007-2016 (pooled) data.*

Remoteness

Daily smoking prevalence declined over time across metropolitan and non-metropolitan locations (Figure 1). Across all years, prevalence was highest for employed Australians in non-metropolitan locations, with non-metropolitan workers 1.4 times more likely to smoke than metropolitan workers. Between 2007 and 2016, a greater reduction in prevalence occurred among metropolitan workers (33%) than non-metropolitan workers (29%), see Table 2. This relationship remained significant after adjusting for other variables (Figure 1). The final logistic regression model shows a steeper decreasing trend in prevalence for metropolitan workers (p=0.023, Figure 2).

Indigenous workers

Prevalence of daily smoking was higher among employed Indigenous Australians than their non-Indigenous counterparts

(Figure 1). Prevalence decreased consecutively among non-Indigenous workers from 18.4% in 2007 to 12.2% in 2016. Conversely, among Indigenous workers, there was a 12% increase in prevalence between 2007 and 2016 (Table 2). In 2016, employed Indigenous Australians were 2.3 times more likely to smoke daily than their non-Indigenous counterparts. Differences in prevalence over time were not significant by Indigenous identity when all relevant variables were included in the first logistic regression model (p=0.235, Figure 1). This non-significant finding may be a function of other demographic factors and limited sample size and power.

Socioeconomic status

Daily smoking prevalence declined between 2007 and 2016 among workers in both low and high SES groups but was highest among low SES workers in all years (Figure 1) with the greatest difference in 2013 (44% lower in the high SES group), see Table 2. SES, however, did not significantly affect prevalence over time when included in the first logistic regression model (p=0.397, Figure 1).

Psychological distress

Among employed Australians, daily smoking prevalence declined between 2007 and 2016 for workers in all psychological distress categories, except those with very high levels of psychological distress (Figure 1). Declines in prevalence among the psychological distress groups were not significantly different in the first regression model (p=0.096, Figure 1).

Table 2: Proportion (weighted frequencies) of daily smokers in the employed Australian population over time by key demographic variables.

Demographics	2007	2010	2013	2016
Sex*				
Male	19.9 (1,047,620)	17.2 (934,177)	15.2 (856,708)	14.5 (816,644)
Female	16.6 (672,315)	14.7 (622,206)	11.4 (498,177)	10.2 (491,756)
Age groups				
14-24 years	17.0 (223,971)	13.8 (177,504)	14.7 (183,436)	12.8 (155,092)
25-39 years	20.9 (650,884)	17.4 (572,491)	13.5 (458,376)	12.7 (464,109)
40-59 years	18.3 (771,249)	16.6 (723,004)	14.0 (631,130)	13.1 (602,883)
60+ years	10.9 (73,832)	11.5 (83,384)	9.6 (81,942)	8.8 (86,315)
Aboriginal and/or Torres Strait Islander				
Yes	24.8 (23,740)	30.0 (37,954)	30.1 (46,089)	27.7 (62,063)
No	18.4 (1,678,503)	15.9 (1,504,385)	13.3 (1,298,669)	12.2 (1,239,752)
State				
New South Wales	18.2 (537,923)	15.1 (462,984)	12.8 (388,307)	11.8 (389,611)
Victoria	18.7 (433,067)	15.8 (374,109)	13.2 (333,154)	12.5 (337,104)
Queensland	18.9 (361,875)	17.9 (355,709)	15.4 (314,623)	14.2 (292,524)
Western Australia	16.1 (153,560)	16.5 (172,374)	13.7 (155,582)	12.0 (137,233)
South Australia	17.8 (122,519)	16.0 (108,097)	11.6 (83,803)	10.9 (75,985)
Tasmania	27.1 (54,269)	15.6 (32,912)	15.8 (35,511)	16.1 (33,915)
Australian Capital Territory	16.1 (28,362)	11.9 (22,535)	9.2 (17,469)	10.2 (19,741)
Northern Territory	27.0 (28,359)	23.3 (27,663)	20.9 (26,435)	17.0 (22,287)
Remoteness*				
Metropolitan	16.7 (1,064,988)	14.7 (981,066)	11.7 (833,650)	11.1 (827,489)
Non-metropolitan	22.4 (653,831)	19.3 (575,316)	18.2 (521,235)	16.0 (480,910)
Socioeconomic status[a]				
Low	25.1 (724,811)	21.7 (692,639)	19.2 (628,995)	16.5 (614,784)
High	15.5 (994,007)	13.3 (863,744)	10.8 (725,889)	10.3 (693,616)
Psychological distress[b]				
Low	16.4 (1,082,525)	14.9 (1,023,830)	11.9 (844,690)	11.4 (812,351)
Moderate	21.6 (421,843)	18.3 (358,336)	15.8 (321,310)	12.6 (277,784)
High	25.5 (157,268)	22.0 (136,653)	20.7 (130,835)	18.1 (145,469)
Very high	39.3 (48,726)	21.8 (34,155)	26.7 (51,810)	28.6 (66,941)

Notes:

Source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007, 2010, 2013, 2016: Confidentialised unit record file. Canberra: Available from the Australian Data Archive; 2017.

** P-values for interactions between demographic variables and survey year are adjusted for sex, age, Aboriginal and/or Torres Strait Islander status, remoteness, socioeconomic status and psychological distress using the survey weighted logistic regression model. Group differences significant at p<0.05.*

a: Groups based on quintile range: Low SES = 1st and 2nd quintile; High SES = 3rd-5th quintile.

b: Groups based on how respondents scored on the psychological distress scale: Low = 10-15; Moderate = 16-21; High = 22-29; Very high = 30-50.

Age and sex

In the final regression model, smoking prevalence was higher in employed males aged 14–59 years compared to employed females, with the greatest difference among those aged 14–39 years (p=0.004 age and sex interaction). Among male and female workers aged 60 years and over there was no statistically significant difference in daily smoking (Figure 2).

Age and socioeconomic status

Daily smoking prevalence was significantly higher among low SES workers across all age groups compared to high SES workers (Figure 2). Low SES workers aged 40–59 years had the largest difference in prevalence compared to their high SES counterparts. The smallest difference in prevalence by SES occurred among workers aged 14–24 years (p<0.001 age and SES interaction).

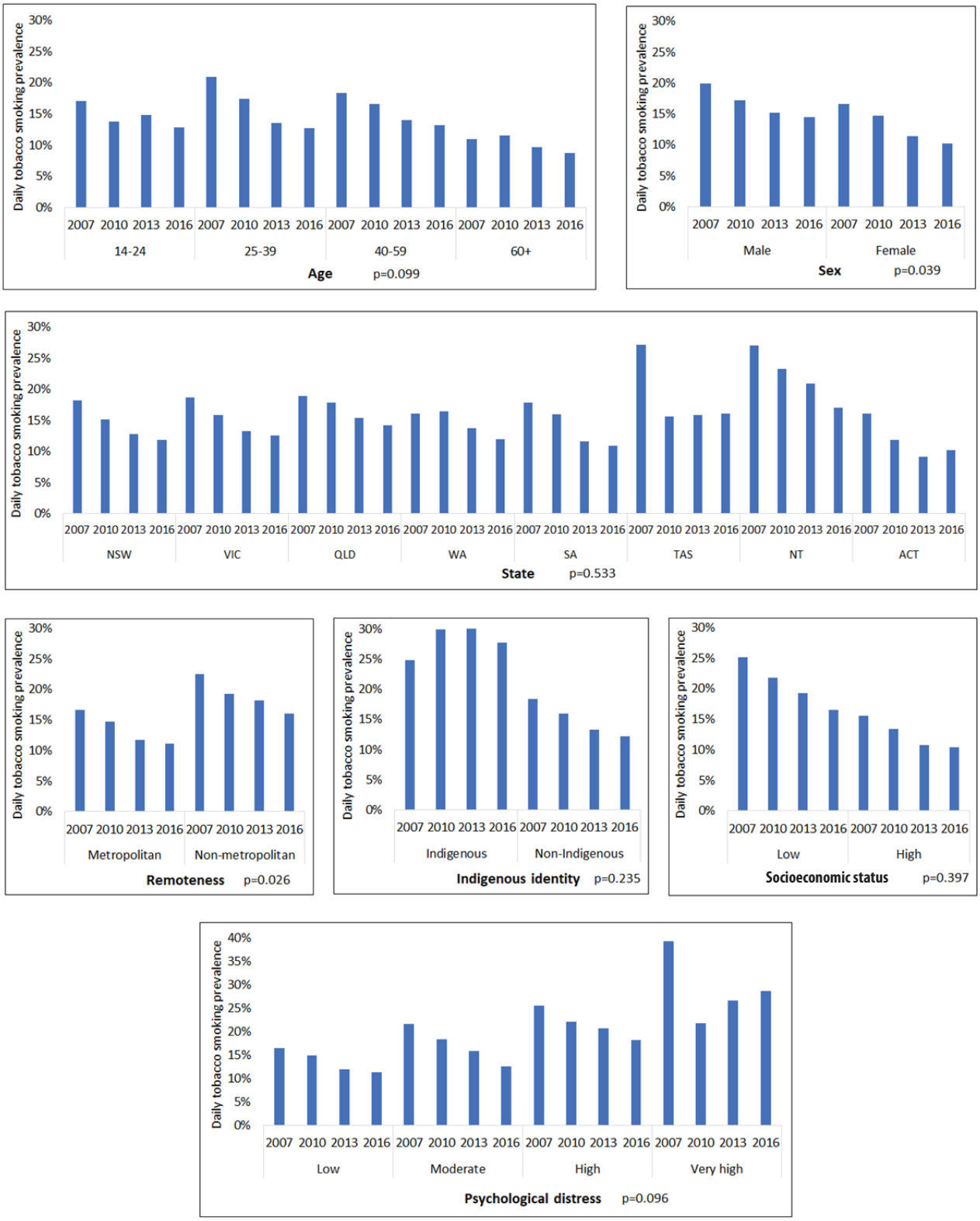
Remoteness and socioeconomic status

The final regression model found daily smoking prevalence was highest among low SES workers from non-metropolitan locations and lowest among high SES workers from metropolitan locations. The difference in prevalence between low and high SES workers was greatest in metropolitan locations (p=0.033 remoteness and SES interaction, Figure 2).

Discussion

This study presents a comprehensive examination of Australian workers' daily smoking from 2007 to 2016 and highlights policy and intervention implications. Workers' smoking prevalence declined significantly during this period, consistent with the Australian population and global trends (e.g. global rates decreased 6.7% for those aged 15+ 2000–2015[27]). The trend for decreased daily tobacco smoking among Australian workers continues an established pattern,[12,13,28] similar to other countries.[29] However, declines in workers' smoking prevalence were not evenly distributed, with male workers and non-metropolitan workers showing the smallest decline over time. Workers with higher smoking levels were males aged 14–39 years; non-metropolitan workers overall and low SES non-metropolitan workers; and low SES workers aged 40–59 years. Indigenous workers' smoking was 2.3 times higher in 2016 than non-Indigenous workers with little

Figure 1: First logistic regression model: Daily smoking prevalence of employed Australians by year and age, sex, state/territory, remoteness, Indigenous identity, socioeconomic status and psychological distress, 2007-2016.



Notes:

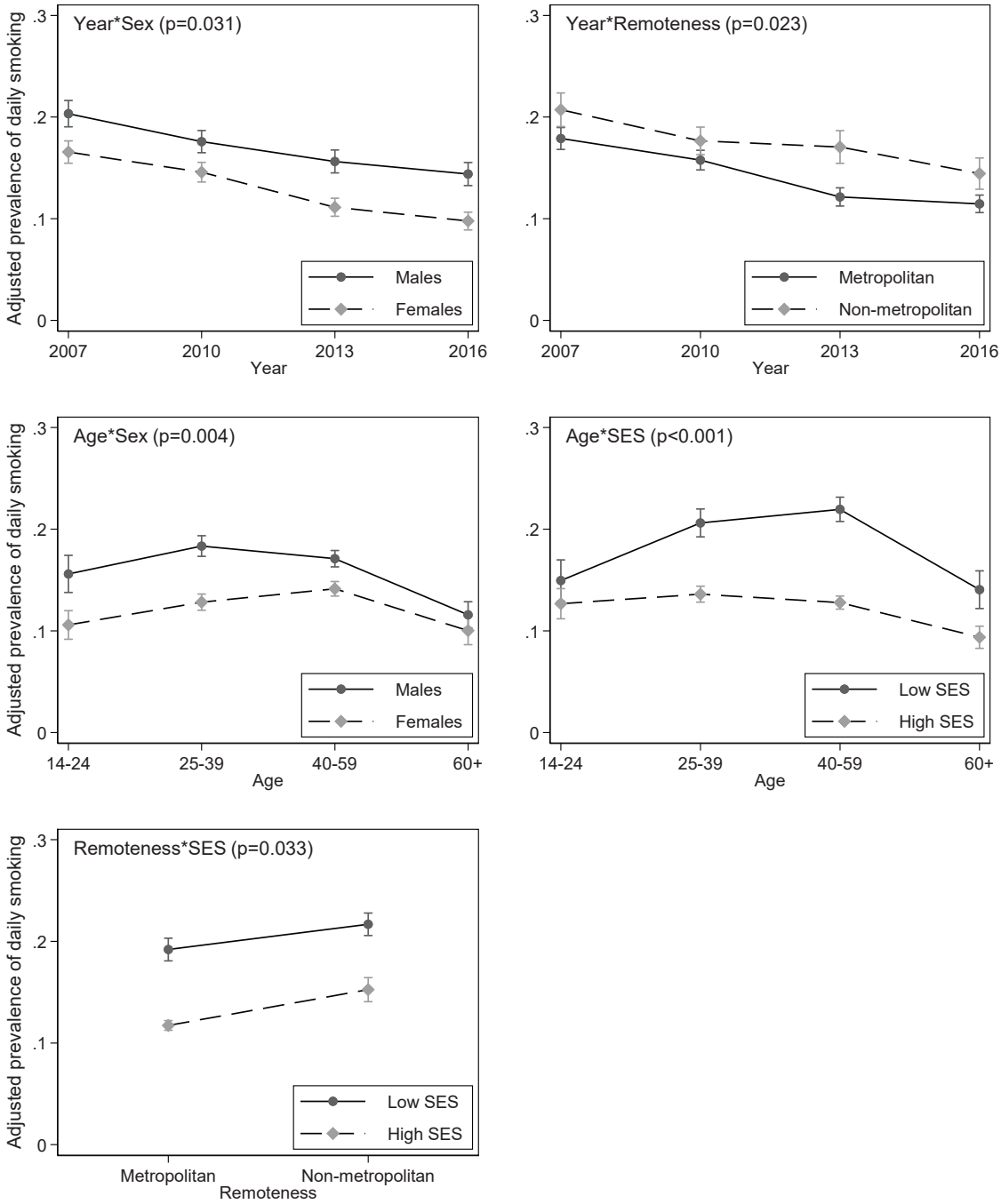
Source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007, 2010, 2013, 2016: Confidentialised unit record file. Canberra: Available from the Australian Data Archive; 2017.

p-values for interactions between demographic variables and survey year are adjusted for age, sex, remoteness, Aboriginal and/or Torres Strait Islander status, socioeconomic status and psychological distress using the survey weighted logistic regression model.

apparent improvement over time; an issue of concern given recent research indicating that approximately half of all deaths of Indigenous persons over 45 are due to smoking.[30]

These groups of workers have distinct demographic profiles, and their workplaces and working environments offer unique, if under-utilised, opportunities for tailored approaches to smoking cessation. Workplace smoke-free policies, tobacco control interventions and cessation programs, in addition to broader societal changes (e.g. tobacco taxes, smoking laws, social norms, and pervasive health messages[31]), have played a pivotal role in reducing workers' smoking behaviour.[13,15,16] Implementation of extensive smoke-free environments, including workplaces, is a great success for tobacco control in Australia.[32] However, the present findings highlight important variations in smoking prevalence among workforce sub-populations and indicate the need for tailored policies, prevention and intervention strategies. The application of proportionate universalism is supported where whole-of-population/workplace approaches are accompanied by measures

Figure 2: Final logistic regression model: interaction effects of daily smoking prevalence among employed Australians over time, 2007-2016.



Notes:

Source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007, 2010, 2013, 2016: Confidentialised unit record file. Canberra: Available from the Australian Data Archive; 2017.

SES = Socioeconomic status

tailored to the needs of specific groups.[33] Specific strategies are required to achieve effective reductions in smoking prevalence among the five identified at-risk workforce subgroups, i.e. male workers, especially those aged 14–39; non-metropolitan workers, including low SES non-metropolitan workers; and low SES workers in general, and especially those aged 40–59. Overall, smoking rates have declined more steeply among females than males, and metropolitan vs. non-metropolitan workers – highlighting the need to focus greater attention on smoking among males and rural and remote workers.

As the workplace has proved to be a crucial setting in which to introduce highly effective smoking behaviour change,[14] the current data provide insights into ways that further refinement might be achieved in this key health promotion setting. Current workplace smoke-free policies, smoking prevention, intervention and cessation programs may need to be strengthened to better target the specific at-risk work groups identified. Scope exists to expand innovative options such as the provision of discounted or subsidised pharmacotherapy, strengthening the role of Employee Assistance Programs in smoking cessation counselling efforts and facilitating the introduction and uptake of smoking cessation apps.[34]

Sex-specific issues

Consistent with the extant literature on predictors of tobacco smoking,[12,28] males in general and younger males in particular, were found to have a higher prevalence of daily smoking than female workers, placing them at greater risk of tobacco-related harms. However, it is also noted that even with lower prevalence levels women have a higher burden of smoking-related diseases than men.[29] Hence, sex is an issue of ongoing salience in smoking cessation efforts. One possible factor contributing to higher smoking prevalence among male workers may relate to their industry of employment and corresponding levels of implementation of workplace smoke-free policies. For instance, the construction industry is male-dominated,[35] has a high prevalence of daily smoking, and construction-related outdoor worksites may be exempt from the *Tobacco Products Regulation Act* 1997 and/or relevant state/territory smoking laws regarding outdoor areas.[31] Consequently, smoking cessation, prevention and intervention efforts may need to be revised and strengthened within such industries. Implementation of a universal smoke-free workplace policy or individual workplace policies that extend to unregulated outdoor areas and worksites may assist efforts towards reducing the prevalence of smoking among select at-risk groups.

Age and sex

The significantly higher level of daily smoking among young males (aged 14–39 years) underscores the need to also emphasise early life stage strategies to circumvent the initial uptake of smoking. It is accepted that unless a person starts to smoke before their early 20s they are unlikely to be a smoker later in life.[36] Hence, there is an opportunity for workplaces to strengthen strategies specifically designed to prevent the uptake of, or curtail, smoking among young workers. There is also untapped scope to address smoking in Technical And Further Education (TAFE) and related apprenticeship training programs.[37]

Location-specific factors

Workers in non-metropolitan locations, in general, were also significantly more likely to be daily smokers, especially low SES workers in non-metropolitan locations. Australians who live in non-metropolitan areas have well-established patterns of higher risk and morbidity across a wide range of areas including AOD use, suicide, mental health and dental care.[38] Factors associated with elevated levels of risk behaviours (including daily smoking) among non-metropolitan workers include low education attainment, low income, low SES and blue-collar occupations. While higher rates of smoking in non-metropolitan locations have been recognised for some time[39] effective cessation strategies remain an issue of current investigation,[40] with real-time video counselling[41] and other online mechanisms showing potential and effective engagement of health care workers pivotal.[39]

Workers who smoke experience more general health problems and have more time off work,[5] further compounding financial disadvantage often experienced among Australians in non-metropolitan areas.[42] An economic and equity imperative[5] exists to develop more effective strategies that are appropriately designed to meet the needs of non-metropolitan, and notably, low SES non-metropolitan Australians and to address the specific factors that contribute to their higher levels of smoking.

Socioeconomic status

The final demographic subpopulation identified to have elevated levels of daily smoking was 40–59-year-old workers from the low SES group. Previous research has reported on the accumulation of 'hard core smokers' among low SES groups.[43] This group of smokers represents a range of challenges. They are sometimes referred to as recalcitrant smokers who have smoked for several decades, often made multiple attempts to quit and have difficulty in giving up. As a low SES group, they also often lack the advantages of a wider range of social and other supports that may be conducive to quitting. Workplaces can support these workers to quit through incentives, other forms of inducements, stress management techniques[44] and changing workplace cultural norms.

Indigenous workers

Although Indigenous workers were not included in the at-risk groups identified in the final adjusted model, their generally high and sustained level of smoking is worthy of mention. No significant reductions in prevalence were found among this group over time despite decreased prevalence among Indigenous people in general,[45] largely reflecting the small sample size and limited power, and it calls for a more specific examination from a workplace intervention perspective.

Strengths and limitations

The finding that the single demographic and health variables of age, Indigenous identity, SES, and psychological distress were not significantly associated with daily smoking rates in the adjusted models contrasts with some prior research.[31,43,46] The modelling used in the present study accounted for multiple interaction effects and highlights its utility in identifying the main contributory factors to daily smoking among workers.

There are several limitations to the study. First, NDSHS data is based on self-report and may be subject to recall and response bias. Respondents may not reliably indicate their smoking status or may deny or inaccurately report the frequency of use.[47] Second, sampling bias may have underestimated the prevalence of daily smoking as the NDSHS does not sample particular subgroups which may have higher daily tobacco use. Potential respondents may have also declined or

been unavailable to participate due to poor health derived from their tobacco use. Third, smoking data has been collected nationally via two representative data sources: The NDSHS and the National Health Survey (NHS). The two sources produced different daily smoking estimates with prevalence lower among NDSHS respondents. However, both reported similar trends in daily smoking prevalence.[48] Had NHS data been used, it is doubtful that different at-risk subgroups would emerge. Overall, the data presented here are considered conservative and actual prevalence may be higher than reported. Future work is required to examine smoking patterns and prevalence among workers across specific industry and occupational groups.

Conclusion

This study found disparities in tobacco smoking prevalence among employed Australians that did not dissipate over time. Although Australia has implemented effective tobacco control initiatives with relatively low smoking rates compared to other nations, the prevalence of daily smoking among certain workforce subgroups remains comparatively high. As such, there is a pressing need for more finely targeted smoke-free policies, prevention and intervention strategies in the workplace to better assist at-risk groups to abstain, reduce or quit. Effective strategies can improve workers' health and create substantial savings to the workplace and Australia's economy.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary Table 1: Adjusted effects of demographics on employed Australians' daily smoking prevalence from Model 1, which includes significant demographics and survey year as main effects.

Supplementary Table 2: Adjusted effects of demographics on employed Australians' daily smoking prevalence from Model 2, which includes all main effects from Model 1 as well as 2 interaction terms: survey year with sex and survey year with remoteness.

Supplementary Table 3: Adjusted effects of demographics on employed Australians' daily smoking prevalence from Model 3, which includes all variables in Model 2 as well as 3 interaction terms: age with sex, age with SES and remoteness with SES.