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Original Investigation

Patterns and Prevalence of Daily Tobacco Smoking in Australia by Industry and Occupation: 2007–2016

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Abstract

Introduction: Australian workers' daily tobacco smoking over time was examined by industry and occupation, to identify factors associated with high and/or low prevalence.

Aims and Methods: Secondary analyses of 2007, 2010, 2013, and 2016 National Drug Strategy Household Surveys were undertaken (pooled $n = 49\,395$). Frequency analyses informed subsequent modeling of select industries and occupations. Four logistic regression models estimated adjusted effects of demographics on daily smoking in industries with high (≥20%) and low (≤15%) daily smoking prevalence and occupations with high (≥20%) and low-moderate (<20%) daily smoking prevalence.

Results: The sample comprised 55.7% men, 34.1% 25–39-year-olds, 31.4% New South Wales residents, 70.1% metropolitan residents, 66.9% high socioeconomic status workers, and 70.6% with low psychological distress. Daily smoking prevalence differed by industry and occupation in 2007, generally decreasing between 2007 and 2016. In high prevalence industries, daily smoking was associated with male gender and age (25–39-year-olds) and in low prevalence industries with males and nonmetropolitan workers. In high prevalence occupations, daily smoking was associated with males, female nonmetropolitan workers, and age 25–39 years and in low-moderate prevalence occupations with nonmetropolitan workers and negatively associated with females aged 14–24 years. In all models, increased odds of daily smoking were associated with low socioeconomic status and very high psychological distress.

Conclusions: Low socioeconomic status and very high psychological distress were risk factors for daily smoking regardless of industry, occupation, or high preexisting smoking prevalence. Targeted, as well as universal, interventions are required for workplaces and workers with greatest smoking vulnerability and least smoking cessation progress.

Implications: Specific strategies are warranted for identified industries, occupations, and subgroups with increased odds of daily tobacco smoking. Industries and occupations with low-moderate smoking prevalence may confer workers some protection but are not without risk; some subgroups in these settings (eg, nonmetropolitan areas) had elevated daily smoking risk. Hence, the following are supported: (1) universal interventions directed at low socioeconomic workers and workers with very high psychological distress regardless of workplace; (2) interventions targeted at high prevalence industries; (3) cessation efforts targeted for young workers in high prevalence industries and occupations; and (4) focused interventions addressing specific needs of nonmetropolitan at-risk workers in low prevalence industries.

Introduction

Tobacco use and exposure to secondhand smoke have substantial negative impacts on health and are leading preventable causes of death and disease.[1,2] People who smoke tobacco long term live 10–11 fewer years than those who have never smoked.[3] Smoking is associated with cancer, cardiovascular disease, and respiratory diseases, approximately one-in-ten deaths,[1] and 9.3% of Australia's total burden of disease.[1] The workplace has been central to Australia's smoke-free policies[4] and provides a prime, if underutilized, location for prevention and intervention.

Achieving extensive smoke-free environments is described as one of the great success stories of tobacco control in Australia.[5] Correspondingly, general population smoking prevalence in Australia has declined markedly,[6] although rates of decrease have slowed more recently. The workplace has played a pivotal role in the decline in smoking among employed people.[6–10] Workplace smoke-free policies have improved air quality, helped people quit smoking, reduced ill-health effects from smoking for both those who smoke and coworkers, reduced exposure to secondhand smoke, and reduced smoking initiation.[11] Workplace cessation programs, counseling, health promotion programs, access to health professionals, and assistance with cessation medication have contributed to improvements in worker health, increased productivity, and reduced workplace tobacco-related costs.[11]

However, decreases in smoking prevalence among workers have not been uniform. Variations in smoking prevalence among workers have also been observed in other countries,[12–14] with diverse contributory sociodemographic and employment-related factors identified. The primary workplace activities and workers' job roles are important determinants of health behavior, with substantial differences documented in smoking prevalence by occupation and industry.[15] For instance, smoking prevalence in the construction industry has remained comparatively high,[10,12] potentially reflecting the universally male-dominated gender composition of that workforce[10,16] with males traditionally more likely to smoke daily.[7,8] Workplace location and setting are further potential contributory factors. Worksites, such as those in the construction industry, are usually located outdoors and may be exempt from national or local laws regarding smoking in outdoor areas.[4] Hence, there may be fewer constraints on smoking in such workplace settings.[12] In general, a multitude of complex push–pull factors interact to influence smoking behaviors in the workplace. Drivers may include working-class cultures of defiance, employer's politics of control and suppression, and consequent challenges to employer authority.[17]

Despite recent advances regarding occupational health and safety, some workers may still be negatively impacted by coworkers' tobacco use. In 2016, tobacco-related illness and ill health contributed to 11.3 billion extra days of workplace absenteeism and 2.0 billion days of presenteeism in Australia, at a cost of AU $5 billion.[18] The total cost of lost productivity because of smoking has been estimated at AU $388 billion over the working life of the Australian population.[19] These estimates exclude costs from the loss of workers because of premature mortality and are only associated with the user. People who refrain from smoking are also at risk of ill-health consequences derived from secondhand smoke exposure,[1] with important policy implications for workers and workplaces.

Although tobacco smoking in Australia has declined significantly over time,[20] prevalence varies by population subgroups.[2] Smoking prevalence is generally higher among people with lower socioeconomic status (SES), income, occupational status, and education.[2,21,22] Prevalence is also higher among nonmetropolitan Australians.[6] However, it is unclear how smoking declines are precisely dispersed among Australian workers and how they vary across industry, occupational, and demographic subgroups. It is also unclear why the prevalence of daily tobacco smoking differs between some industry and occupation groups, and whether the demographic profile of those who smoke tobacco differs between industries and occupations with high and low daily smoking prevalence.

The workplace plays an important contributory role in the uptake and continuance of smoking.[8] It has played a pivotal role in the implementation of behavior change strategies and smoking cessation policies, including the enforcement of smoke-free workplaces.[9–12,23] Hence, examining the changing patterns and prevalence of daily smoking by industry and occupation of employment is important. While there is strong evidence regarding the sociodemographic factors associated with smoking, there has been comparatively limited examination of the patterns and prevalence of daily smoking over time among Australian industries and occupations. The present study aimed to examine the following research questions:

1. Which industries and occupations in Australia had high and low daily tobacco smoking prevalence?
2. What was the change in prevalence of daily tobacco smoking by industry and occupation between 2007 and 2016?
3. What demographic and mental health profiles (gender, age, occupation, state, remoteness, SES, and psychological distress) were associated with daily tobacco smoking in high and low prevalence industries and occupations?

Materials and Methods

Data Source

Data from four nationally representative triennial National Drug Strategy Household Surveys (NDSHSs) were used (2007,[24] 2010,[25] 2013,[26] and 2016[27]). The NDSHS is a cross-sectional survey of Australia's general population. Questions assess respondents' attitudes, opinions, and behavior regarding tobacco, alcohol, and illicit drug use. Multistage stratified sampling techniques were used, with participation sought from one respondent per selected household after contact was established by survey staff. In 2010 and 2013, all responses were collected via self-complete "drop and collect" paper surveys; most participation was also via this mode in 2007 (85%) and 2016 (78%). In 2016, 22% of responses were via online survey, with all other participation (15% in 2007 and 0.3% in 2016) via computer-assisted telephone interview. Response rates ranged from 49.1% to 51.1% across the four surveys.

Data were weighted (by household size, age, and gender within geographic strata) to be representative of the total Australian population,[28] and daily smoking trends similar to other representative Australian data sources have been reported in the NDSHS over time.[29] Detailed NDSHS methodology has been published elsewhere.[28]

Data from employed participants (≥14 years) across the four survey years were analyzed (n = 49 395; weighted N = 39 428 968). Of the pooled data, 23.9% was from 2007 (weighted N = 9 322 044), 27.5% from 2010 (weighted N = 9 665 418), 24.7% from 2013 (weighted N = 10 003 648), and 23.9% from 2016 (weighted N = 10 437 858).

Measures

Participants who responded to the employment status question ("Which of the following best describes your main current employment status?") that they were "self-employed" or "employed for wages, salary, or payment in kind" were included in the analysis. Question and response options were consistent for 2010–2016 but varied from 2007 (the term "main" was not included in the question, nor was the response option "self-employed").

Smoking status was determined via the "summary of tobacco use" variable (TobSum) derived (by the survey custodians) from six questions (identically worded across survey years) that assessed respondent's lifetime, past year, and frequency of tobacco product use. Tobacco products included cigarettes, cigars, pipes of tobacco, and other forms of tobacco that are smoked. The TobSum variable was used first to determine the proportion of people who smoked daily. "Daily smoking" data (as opposed to all people who smoke including occasionally) were used in this study as it is associated with greatest harm and presents greatest prevention challenges. Nonsmoked tobacco products were not included here as types of products asked about were not consistent over time and frequency of use was not assessed.

Industry of employment and occupation were determined based on open text responses to the questions: "What kind of industry, business, or service is carried out by your main employer (or employer when you last worked)?" (worded as "What kind of industry, business, or service is/was carried out by your main or last employer?" in 2007) and "What kind of work do you do (or did you do when you last worked)?" Industry was classified according to the 2006 Australian and New Zealand Standards Industrial Classification (ANZSIC) into 19 industry groups (see Figure 1). All survey years used the 2006 ANZSIC, however, the version used varied. The original version was used in the 2007 NDSHS; the first revision (2008) was used in the 2010 and 2013 NDSHS; the second revision (2013) in the 2016 NDSHS. Variations to ANZSIC were minor for each revision.[30]

Occupation coding varied across survey years: the Australian Standard Classification of Occupations (ASCO) Second Edition was used to code occupations in 2007; the Australian and New Zealand Standard Classification of Occupations (ANZSCO) was used to code occupations from 2010. For confidentiality reasons, the lowest occupation level available in the NDSHS confidentialized unit record file (CURF) is the 2-digit "submajor level" (second highest level of a five-level hierarchy).[27] For consistency across time, the 2007 ASCO data were recoded to best match ANZSCO occupation data. Occupation was then recategorized into one of five groups: managers (ANZSCO codes: 11–14), professionals (ANZSCO codes: 21–27), trade workers (ANZSCO codes: 31–39), skilled workers (ANZSCO codes: 41–45, 51–59, and 71–74), and unskilled workers (ANZSCO codes: 61–63 and 81–89).

Demographic variables of interest were gender (male, female), age (14–24, 25–39, 40–59, ≥60), state of residence, remoteness (metropolitan [major city], nonmetropolitan [comprising all

High prevalence industries (≥20%)*		**Moderate prevalence industries** (15%<20%)*		**Low prevalence industries** (≤15%)*	
TPW	Transport, Postal and Warehousing	AFF	Agriculture, Forestry and Fishing	PAS	Public Administration and Safety
ASS	Administrative and Support Services	RT	Retail Trade	HCSA	Health Care and Social Assistance
AFS	Accommodation and Food Services	OS	Other Services	RHRES	Rental, Hiring and Real Estate Services
Ma	Manufacturing	ARS	Arts and Recreation Services	IMT	Information Media and Telecommunications
C	Construction	WT	Wholesale Trade	FIS	Financial and Insurance Services
Mi	Mining	EGWWS	Electricity, Gas, Water and Waste Services	PSTS	Professional, Scientific and Technical Services
				ET	Education and Training

Figure 1. Daily tobacco (tobacco products included cigarettes, cigars, pipes of tobacco, and other forms of tobacco that are smoked) smoking prevalence by industry of employment: 2007 versus 2016. Data source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007 and 2016: Confidentialized unit record file. *Classification of each industry into one of three prevalence groups was based on their smoking prevalence estimate in 2007.

regional and remote areas[31]]), and SES (low [first and second quintile], high [third to fifth quintile][32]). Kessler's 10-item (K10) scale (eg, "In the past 4 weeks, about how often did you feel nervous") was used to determine psychological distress level: low, score 10–15; moderate, score 16–21; high, score 22–29; and very high, score 30–50.[33,34] Across the four surveys, age, occupation, and psychological distress were similarly worded. Gender questions varied over time: "Are you male or female?" (yes, no) was reworded in 2016 to "What is your sex?" (male, female, other). For confidentiality, 23 respondents selecting "other" in 2016 were excluded from the CURF datasets.[27].

Analysis

Analyses used STATA (version IC 15).[35] Data were pooled from four NDSHS surveys. Absolute person weights (available for each survey year) were used to weight responses to the Australian population. Frequency analyses and significance testing ($p \leq .05$) explored differences in daily smoking prevalence over time for industry of employment, occupation, and across subgroups.

High daily smoking prevalence industries and occupations were those where at least 20% of employees smoked daily in 2007 (referred to hereon as high prevalence industries and high prevalence occupations). Low daily smoking prevalence industries were those where at most 15% of employees smoked daily in 2007 (referred to hereon as low prevalence industries); occupations where less than 20% of employees smoked daily in 2007 were deemed to have low-moderate prevalence (referred to hereon as low-moderate prevalence occupations). These cutoffs were applied to the 19 industry and 5 occupation groups to allow meaningful comparisons based on the observed distributions in the data. The frequency analyses informed the multivariable logistic regression models performed. Demographic profiles were compared, and separate models run for workers who smoked daily in (1) high prevalence industries, (2) low prevalence industries, (3) high prevalence occupations, and (4) low-moderate prevalence occupations. The models adjusted for six demographic variables (including psychological distress) and examined their effects on daily smoking prevalence over time. The seventh variable was occupation for the industry models and industry (dichotomized to high and/or low prevalence industries) for the occupation models. Each individual demographic variable, their interaction with survey year, and two-way interaction between demographic variables were explored. Individual items significant at $p \leq .05$ were included in the final multivariable models.

Final models for both high and low prevalence industries included all seven demographic variables and survey year. There were no significant interactions included in the industry models. The final model for high prevalence occupations included six demographic variables (gender, industry, remoteness, state, SES, and psychological distress), survey year, and two interaction effects (age by industry, gender by remoteness); the final model for low-moderate prevalence occupations included six demographic variables (gender, industry, remoteness, state, SES, and psychological distress), survey year, and one interaction effect (age by gender).

Results

The sample comprised 55.7% men, 34.1% 25–39-year-olds, 31.4% New South Wales residents, 70.1% metropolitan residents, 66.9% high SES workers, and 70.6% workers with low psychological distress. Demographic profiles of industries and occupations by daily smoking prevalence are detailed in Supplementary Table S1.

Industry of Employment

Industries With High and Low Daily Smoking Prevalence

In 2007, daily smoking prevalence varied considerably across the 19 industry groups (Figure 1). Six industries recorded daily smoking prevalence levels of at least 20% in 2007 and were classified as high prevalence industries. Workers in Transport, Postal, and Warehousing (28.0%) had the highest daily smoking prevalence followed by Administration and Support Services (27.4%) and Accommodation and Food Services (25.8%).

Conversely, seven industries had daily smoking prevalence levels of at most 15% in 2007 and were classified as low prevalence industries. Workers in Education and Training (7.8%), Professional, Scientific, and Technical Services (11.2%), and Financial and Insurance Services (13.0%) had the lowest prevalence of daily smoking.

Change in Daily Smoking Prevalence by Industry

Daily smoking prevalence declined between 2007 and 2016 in all industries by 20.2%–77.0%, except Electricity, Gas, Water, and Waste Services (where prevalence increased 23.6% [2007: 16.3%; 2016: 20.1%]). Greatest reduction in daily smoking prevalence occurred in industries where prevalence was initially low (eg, Financial and Insurance Services [2007: 13.0%; 2016: 3.0%; reduction of 77.0%]; Information Media and Telecommunications [2007: 14.0%; 2016: 5.9%; reduction of 57.6%]; and Professional, Scientific, and Technical Services [2007: 11.2%; 2016: 5.9%; reduction of 49.2%]). Of the six industries with at least 20% daily smoking prevalence in 2007, Mining had the largest (45.4%) and Construction the smallest (21.1%) reduction in daily smoking between 2007 and 2016 (Figure 1).

Risk Factors for Daily Smoking by Industry

Seven of the eight variables included in the low prevalence industry and high prevalence industry models were found to be significantly associated with daily smoking. Six of these variables were consistent in both models: survey, gender, state, SES, psychological distress, and occupation. In both high and low prevalence industries, odds of smoking on a daily basis were greater for workers who were male, with low SES, high levels of psychological distress, living in the Northern Territory, and whose occupation was either unskilled, skilled, or trade; there were also reduced odds in the multivariable model of daily smoking in later survey years (Table 1). The strength of association between psychological distress and daily smoking differed between industry prevalence groups: odds of daily smoking among workers with very high levels of psychological distress (vs. those with low distress) were double in high prevalence industries (OR = 2.34, 95% CI = 1.67% to 3.28%) but triple in low prevalence industries (OR = 2.92, 95% CI = 2.05% to 4.14%) (Table 1).

The differences in the two models were that remoteness was a significant factor in the low prevalence industry model, while age was significant in the high prevalence industry model. Nonmetropolitan workers in low prevalence industries had higher odds of daily smoking than metropolitan workers. Workers aged 25–39 years in high prevalence industries had significantly higher odds of daily smoking than workers aged at least 60 years (Table 1).

Table 1. Daily Tobacco[a] Smoking Risk Factors for Industries With High and Low Daily Smoking Prevalence[b]

	High prevalence	Low prevalence
Risk factor	**OR (95% CI)**	**OR (95% CI)**
*Survey year****,†††	0.95 (0.93, 0.96)	0.93 (0.91, 0.94)
*Gender***,††		
Females	0.85 (0.76, 0.95)	0.85 (0.75, 0.95)
*Age group****		
14–24	1.27 (1.00, 1.62)	0.80 (0.58, 1.12)
25–39	1.90 (1.55, 2.33)	1.05 (0.87, 1.27)
40–59	1.63 (1.34, 1.99)	1.10 (0.92, 1.32)
*State****,††		
Victoria	0.99 (0.85, 1.16)	1.01 (0.87, 1.18)
Queensland	1.02 (0.87, 1.19)	1.05 (0.89, 1.24)
Western Australia	0.79 (0.65, 0.96)	0.96 (0.78, 1.17)
South Australia	0.84 (0.69, 1.03)	0.87 (0.71, 1.07)
Tasmania	1.02 (0.77, 1.35)	0.88 (0.68, 1.13)
Australian Capital Territory	1.30 (0.94, 1.79)	1.00 (0.79, 1.27)
Northern Territory	1.44 (1.14, 1.83)	1.50 (1.19, 1.89)
Remoteness†††		
Nonmetropolitan	1.06 (0.94, 1.20)	1.28 (1.12, 1.46)
SES[c],***,†††		
High	0.66 (0.59, 0.74)	0.60 (0.53, 0.68)
Psychological distress[d],***,†††		
Moderate	1.26 (1.10, 1.44)	1.56 (1.37, 1.79)
High	1.78 (1.48, 2.14)	2.02 (1.65, 2.47)
Very high	2.34 (1.67, 3.28)	2.92 (2.05, 4.14)
Occupation[e],***,†††		
High prevalence	1.67 (1.45, 1.92)	2.01 (1.80, 2.25)

Reference category: male gender, ≥60 years age group, New South Wales state, metropolitan area, low SES, low psychological distress, and low-moderate prevalence occupation. CI = confidence interval, OR = odds ratio, SES = socioeconomic status. Significant differences for high daily smoking prevalence groups = $^{**}p < .01$, and $^{***}p < .001$. Significant differences for low daily smoking prevalence groups = $^{††}p < .01$, and $^{†††}p < .001$. Data source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007, 2010, 2013, and 2016: Confidentialized unit record file.

[a]Tobacco products included cigarettes, cigars, pipes of tobacco, and other forms of tobacco that are smoked.

[b]Industries were classified as having high or low daily smoking prevalence if ≥20% or ≤15%, of the workforce smoked tobacco daily in 2007, respectively. Six industries were classified as having high daily smoking prevalence (Transport, Postal, and Warehousing; Administrative and Support Services; Accommodation and Food Services; Manufacturing; Construction; and Mining) and seven industries as having low daily smoking prevalence (Public Administration and Safety; Health Care and Social Assistance; Rental, Hiring, and Real Estate Services; Information Media and Telecommunications; Financial and Insurance Services; Professional, Scientific, and Technical Services; and Education and Training).

[c]SES dichotomized as low (first and second quintile) and high (third to fifth quintile).

[d]Psychological distress: low (10–15), moderate (16–21), high (22–29), and very high (30–50).

[e]Occupations were classified as high or low-moderate daily smoking prevalence occupations if ≥20% or <20% of the workforce smoked tobacco daily in 2007, respectively. Three occupation groups were classified as having high daily smoking prevalence (Trade workers, Skilled workers, and Unskilled workers) and two occupations as having low-moderate daily smoking prevalence (Managers and Professionals).

Occupation Groups

Occupations With High and Low-Moderate Daily Smoking Prevalence

Across the five occupational groups, daily smoking prevalence in 2007 varied (Figure 2). Three occupations were classified as high prevalence (≥20%) for daily smoking: unskilled (23.0%), trade (22.9%), and skilled (20.9%) workers. Professionals had the lowest prevalence of daily tobacco use (10.1%), followed by managers (18.4%); these two occupation groups were classified as low-moderate prevalence for daily smoking (Figure 2).

Change in Daily Smoking Prevalence by Occupation

Daily smoking prevalence declined across all occupations over time. Occupations with lowest prevalence in 2007 showed greatest reductions by 2016. Between 2007 and 2016, professionals (lowest prevalence in 2007) reduced their prevalence by 45.6%, managers by 44.2%, skilled workers by 29.5%, trade workers by 28.8%, and unskilled workers (highest prevalence in 2007) by 23.2% (Figure 2).

Risk Factors for Daily Smoking by Occupation

In both occupation prevalence models, state, SES, psychological distress, and survey year were significantly associated with daily smoking; workers with low SES, very high levels of psychological distress, and living in the Northern Territory had increased odds of smoking daily. However, odds of smoking daily among workers with very high psychological distress (vs. those with low psychological distress) were greater for those working in low-moderate prevalence occupations (OR = 3.49, 95% CI = 2.22% to 5.51%) than in high prevalence occupations (OR = 2.38, 95% CI = 1.79% to 3.17%) (Table 2).

Gender, industry, and remoteness were significantly associated with daily smoking in only one of the two occupation models. In the high prevalence occupation model, odds of smoking daily were higher for male workers, while in the low-moderate prevalence occupation model, odds of daily smoking were greater among high prevalence industry workers and nonmetropolitan workers.

There were significant interaction effects which varied between high and low-moderate prevalence occupation groups. The high prevalence occupation model found interaction effects for industry by age and gender by remoteness (significant for females only). High prevalence industry workers' odds of daily smoking increased by 31% among workers aged 14–24 years (OR = 1.31, 95% CI = 1.01% to 1.70%), 107% among workers aged 25–39 years (OR = 2.07, 95% CI = 1.65% to 2.59%), and 71% among workers aged 40–59 years (OR = 1.71, 95% CI = 1.38% to 2.13%) compared to workers aged at least 60 years (Table 2). Low prevalence industry workers' odds of daily smoking were 31% higher among both 25–39-year-old (OR = 1.31, 95% CI = 1.02% to 1.70%) and 40–59-year-old workers (OR = 1.31, 95% CI = 1.03% to 1.67%) but similar for 14–24-year-old workers (OR = 0.97, 95% CI = 0.64% to 1.48%) compared to workers aged at least 60 years; nonmetropolitan female workers had greater odds of daily smoking compared to metropolitan female workers (OR = 1.24, 95% CI = 1.08% to 1.43%). The low-moderate prevalence occupation model found one interaction effect for daily smoking: gender by age. The odds of 14–24-year-old female workers smoking daily decreased by 53% (OR = 0.47, 95% CI = 0.27% to 0.82%) compared to female workers aged at least

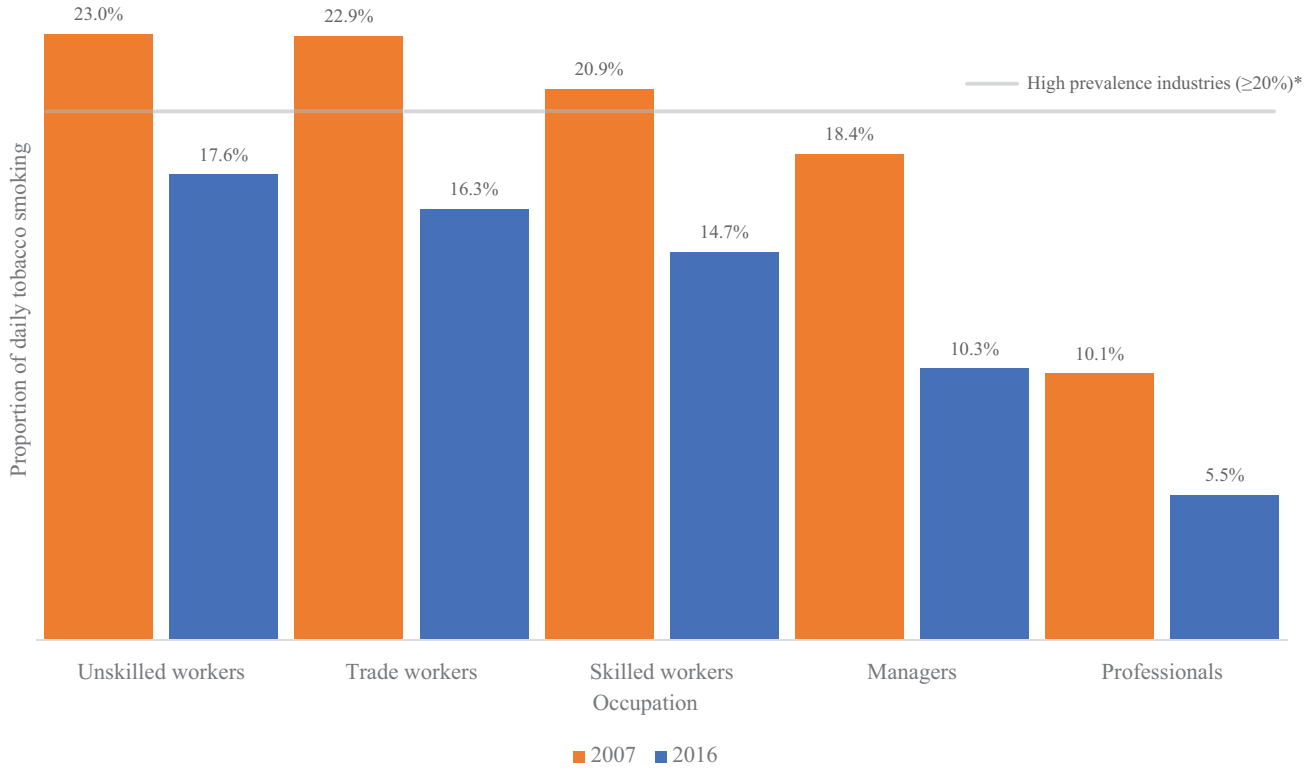

Figure 2. Daily tobacco (tobacco products included cigarettes, cigars, pipes of tobacco, and other forms of tobacco that are smoked) smoking prevalence by occupation: 2007 versus 2016. Data source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007 and 2016: Confidentialized unit record file. *Classification of each occupation into one of three prevalence groups was based on their smoking prevalence estimate in 2007.

60 years. There was no significant gender by age group interaction effect on daily smoking for males.

Discussion

This study presents comprehensive findings on Australian workers' daily tobacco smoking prevalence from 2007 to 2016 by industry and occupational groups. Consistent with decreasing trends for daily smoking in Australia and overseas,[7–9,12] prevalence declined between 2007 and 2016 across nearly all industry and occupation groups. However, the rate of daily smoking decline varied greatly by occupation and industry groups. Importantly, largest decreases in smoking prevalence occurred in workplace settings where prevalence was already low. That is, greatest improvements in smoking were achieved in workplace environments already performing well in smoking cessation. This finding has important implications for future policy and intervention directions.

Workers with greater odds of daily smoking, regardless of occupation and industry, were those who had low SES, very high levels of psychological distress, and were from the Northern Territory (an outlier jurisdiction for numerous health-related outcomes). Odds of daily smoking were also consistently greater for males, and trade, skilled or unskilled workers, across both high and low prevalence industry groups. However, other risk factors associated with daily smoking were unique to some industry or occupation groups or subgroups. For instance, workers aged 25–39 years appear to be more vulnerable to smoking pressures and resistant to cessation measures, if they worked in industries with high daily smoking prevalence overall.[6] In such instances, workplace cultural norms may play an important role in maintaining smoking behaviors.[36] Health-promoting workplace cultural norms also have potential to shape individual behavior change, including smoking cessation,[37] and warrant further attention at the organizational level.

Although various workplace smoke-free policies and cessation programs have been pivotal in reducing smoking, the current findings highlight areas that require more concerted effort and potentially different approaches. Moreover, these findings underscore the need to direct attention to particular industries and occupational groups where base levels of smoking are high and where smaller decreases in smoking cessation have been achieved over time. These are the workplaces with greatest difficulty in decreasing daily smoking prevalence and where explicit attention is required to redress health inequities.[38]

In a more targeted approach, the working environment may be able to provide increasingly nuanced approaches to prevention, intervention, and tobacco control. While acknowledging the importance of universal approaches to health issues in general and tobacco cessation in particular, the evidence here supports a case for both targeted[39] and universal interventions[40,41] and for application of proportionate universalism.[38]

The current findings identified subgroups of workers with increased odds of smoking daily within specific industry and occupation groups, indicating scope for specific workplaces to strengthen their policies, prevention, and intervention programs to match the needs of workers most at-risk. Workplace alcohol and drug policies have demonstrated efficacy.[42] Potential options include incentive schemes for those who previously or never smoked, discounted pharmacotherapy, enhanced cessation counseling, or technology-assisted efforts (ie, smart phone apps).[43]

Table 2. Daily Tobacco[a] Smoking Risk Factors for Occupations With High and Low-Moderate Daily Smoking Prevalence[b]

	High prevalence		Low-moderate prevalence	
Risk factor	**OR (95% CI)**		**OR (95% CI)**	
*Survey year****,†	0.95 (0.93, 0.96)		0.92 (0.90, 0.94)	
*Gender****				
Female	0.78 (0.69, 0.89)		0.99 (0.65, 1.51)	
Gender × *Age*††	*NA*		**Male**	**Female**
14–24			1.22 (0.72, 2.08)	0.47 (0.27, 0.82)
25–39			1.00 (0.73, 1.38)	0.78 (0.55, 1.11)
40–59			0.98 (0.72, 1.32)	1.02 (0.73, 1.43)
Industry[c],†††				
High prevalence	1.25 (0.92, 1.70)		2.18 (1.87, 2.55)	
Industry × *Age**	**Low**	**High**	*NA*	
14–24	0.97 (0.64, 1.48)	1.31 (1.01, 1.70)		
25–39	1.31 (1.02, 1.70)	2.07 (1.65, 2.59)		
40–59	1.31 (1.03, 1.67)	1.71 (1.38, 2.13)		
Remoteness††				
Nonmetropolitan	1.01 (0.88, 1.17)		1.29 (1.08, 1.55)	
Gender × *Remoteness**	**Male**	**Female**	*NA*	
Nonmetropolitan	1.01 (0.88, 1.17)	1.24 (1.08, 1.43)		
*State****,††				
Victoria	1.03 (0.90, 1.17)		0.93 (0.77, 1.13)	
Queensland	1.09 (0.95, 1.25)		0.86 (0.70, 1.06)	
Western Australia	0.84 (0.70, 0.99)		0.90 (0.71, 1.16)	
South Australia	0.90 (0.75, 1.08)		0.72 (0.55, 0.95)	
Tasmania	1.00 (0.80, 1.27)		0.84 (0.58, 1.22)	
Australian Capital Territory	1.10 (0.88, 1.38)		1.00 (0.75, 1.35)	
Northern Territory	1.47 (1.20, 1.79)		1.50 (1.11, 2.02)	
SES[d],***,†††				
Low	1.54 (1.39, 1.70)		1.71 (1.45, 2.01)	
Psychological distress[e],***,†††				
Moderate	1.35 (1.20, 1.52)		1.49 (1.26, 1.76)	
High	1.74 (1.48, 2.04)		2.36 (1.83, 3.04)	
Very high	2.38 (1.79, 3.17)		3.49 (2.22, 5.51)	

Reference category: male gender, ≥60 years age group, New South Wales state, metropolitan area, low SES, low psychological distress, and low prevalence industry. CI = confidence interval, *NA* = interaction term not included in final multivariable model for occupation group, OR = odds ratio, SES = socioeconomic status. Significant differences for high daily smoking prevalence groups = *$p < .05$, and ***$p < .001$. Significant differences for low-moderate daily smoking prevalence groups = †$p < .05$, ††$p < .01$, and †††$p < .001$. Data source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2007, 2010, 2013, and 2016: Confidentialized unit record file.

[a]Tobacco products included cigarettes, cigars, pipes of tobacco, and other forms of tobacco that are smoked.

[b]Occupations were classified as having high or low-moderate daily smoking prevalence if ≥20% or <20% of the workforce smoked tobacco daily in 2007, respectively. Three occupation groups were classified as having high daily smoking prevalence (Trade workers, Skilled workers, and Unskilled workers) and two occupations as having low-moderate daily smoking prevalence (Managers and Professionals).

[c]Industries were classified as having high or low daily smoking prevalence if ≥20% or ≤15%, of the workforce smoked tobacco daily in 2007, respectively. Six industries were classified as having high daily smoking prevalence (Transport, Postal, and Warehousing; Administrative and Support Services; Accommodation and Food Services; Manufacturing; Construction; and Mining) and seven industries were classified as having low daily smoking prevalence (Public Administration and Safety; Health Care and Social Assistance; Rental, Hiring, and Real Estate Services; Information Media and Telecommunications; Financial and Insurance Services; Professional, Scientific, and Technical Services; and Education and Training).

[d]SES dichotomized as low (first and second quintile) and high (third to fifth quintile).

[e]Psychological distress: low (10–15), moderate (16–21), high (22–29), and very high (30–50).

At the individual level, workers with high psychological distress showed most variation in smoking prevalence across diverse settings: for instance, workers with very high psychological distress were twice as likely to smoke daily if they worked in an industry where smoking was generally high. Even more notably, workers with very high psychological distress, in industries where smoking levels were generally low, were three times more likely to smoke daily. Similarly, workers with very high psychological distress in low-moderate prevalence occupations were also more likely to smoke daily, particularly in the occupations with low daily smoking prevalence. This counter-intuitive finding underscores the importance of targeting not just industries with high smoking prevalence but to also focus on vulnerable workers in less obvious settings. Moreover, the relationship between smoking and mental health and the application of effective workplace mental health programs warrants priority attention,[44] particularly given associated economic incentives.[45]

Consistent with previous findings,[7,8] males were more likely to smoke daily regardless of whether they worked in high or low smoking prevalence industries or in a high prevalence occupation.

While efforts targeting male workers are of paramount importance, the present study also found specific subgroups of female workers to have greater daily smoking odds. In several instances, workers in nonmetropolitan locations were also at greater risk of daily smoking, highlighting the complex issues surrounding health disparities for rural populations.[46] Workforce smoking prevention and cessation programs within specific settings need to reflect the gender of the workforce, the context in which they are located, and be tailored accordingly. For example, community intervention programs that address cultural norms of smoking may be particularly effective for rural and lower SES areas.[47]

Strengths and Limitations

A strength of the study is the use of regression modeling which accounted for multiple interaction effects and identified main factors contributing to daily smoking after adjustment. The regression models were informed by frequency analysis of daily tobacco smoking by industry and occupation, which also enabled risk factors to be identified separately for workers from workplace groups with high and low daily smoking prevalence. This approach has potential to identify factors unique to occupational or industrial groups at elevated risk and to inform workplaces about risk factors of greatest salience for targeted policies and programs.

Study limitations include use of self-reported data, where respondents may unreliably report their smoking status and/or frequency of use.[48] Sampling bias may have occurred such that daily smoking prevalence was underestimated, as particular subgroups (which may have higher daily tobacco use; eg, people living in motels and hostels or experiencing homelessness) were excluded from the NDSHS. Tobacco-related poor health may have also resulted in nonparticipation. Workers in transient settings are also less likely to participate in household surveys internationally,[49] and such workers may also have different patterns of tobacco use than those employed in more traditional occupations and industries.

Further, reasons behind the anomalous increase in daily smoking prevalence between 2007 and 2016 for the moderate prevalence industry Electricity, Gas, Water, and Waste Services, despite decreasing prevalence for all other industries, remain unclear. Future analyses may explore risk factors associated with smoking in individual industries, particularly those with least cessation progress. Beyond the current cross-sectional data, future research would benefit from longitudinal studies that observe individual changes across industries and occupations and by ethnic backgrounds. Studies that explore patterns, prevalence, and predictors of all forms of tobacco use are also required, given the present study's limited focus on tobacco products that were only smoked.

Conclusion

Decreases in daily tobacco smoking among workers were found in most industries across a 10-year period. Select workforce subgroups remain at greater risk of daily smoking and its associated harms. Despite the implementation of effective tobacco use policies, programs, and campaigns, which have been central to reducing tobacco use among employed Australians, these workforce subgroups require more targeted prevention and intervention strategies to achieve higher cessation levels. This will foster improvements in workers' health and generate substantial savings to the economies of individual workplaces and Australia nationally.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at https://academic.oup.com/ntr.

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Declaration of Interests

None declared.

Data Availability

The NDSHS data are collected and disseminated by the Australian Institute of Health and Welfare, with access provided via the Australian Data Archive (2007–2016 data available at doi:10.4225/87/T7FITH, doi:10.4225/87/VTUV4C, doi:10.4225/87/USGEQS, and doi:10.4225/87/JUDY2Y).

Authors' Contributions

Alice McEntee: methodology (equal), visualization (lead), and writing—original draft (lead). Susan Kim: methodology (equal), formal analysis (lead), visualization (supporting), and writing—review and editing (supporting). Nathan Harrison: methodology (supporting) and writing—review and editing (supporting). Janine Chapman: conceptualization (supporting), methodology (equal), and writing—review and editing (supporting). Ann Roche: conceptualization (lead), methodology (equal), supervision (lead), and writing—review and editing (lead).

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