

POST-PRINT

This is a post-print (post-refereed, final accepted) version of the manuscript that has been published in Australian and New Zealand Journal of Public Health. The citation details and the link to the final publisher version are below.

Gartner, C., Scollo, M., Marquart, L., Mathews, R. and Hall, W. (2012), Analysis of national data shows mixed evidence of hardening among Australian smokers. Australian and New Zealand Journal of Public Health, 36: 408–414. doi: 10.1111/j.1753-6405.2012.00908.x

Published online 2 Oct 2012

<http://onlinelibrary.wiley.com/doi/10.1111/j.1753-6405.2012.00908.x/full>

Analysis of national data shows mixed evidence of hardening among Australian smokers

Coral Gartner¹, Michelle Scollo², Louise Marquart³, Rebecca Mathews⁴ and Wayne Hall⁴

1 UQ Centre for Clinical Research, The University of Queensland

2 Tobacco Control Unit, Cancer Council Victoria

3 Statistics Unit, Queensland Institute of Medical Research

4 UQ Centre for Clinical Research, The University of Queensland

* Correspondence to: Dr Coral Gartner, UQ Centre for Clinical Research, The University of Queensland, Level 7, Building 71/918, Royal Brisbane and Women's Hospital Site, Herston, QLD 4029; e-mail: c.gartner@uq.edu.au

Keywords: smoking; prevalence; socioeconomic status; psychological distress; hardening hypothesis

Abstract

Objective : According to the ‘hardening hypothesis’, the proportion of smokers that are ‘low-probability quitters’ will increase as societal disapproval of smoking increases. This paper examines whether there has been increased hardening in Australian smokers over the past decade as reflected in an increased prevalence of psychological distress and social disadvantage among current smokers.

Methods: The relationship between psychological distress, living in a disadvantaged area and level of education was determined using logistic regression at two time points 7 to 10 years apart in three cross-sectional household survey series: National Drug Strategy Household Survey (NDSHS), National Health Survey (NHS) and National Survey of Mental Health and Well-being (NSMHW).

Results: The relationships between smoking and living in the most disadvantaged areas and having completed less than 12 years of schooling strengthened between 2001 and 2010 in the NDSHS, but there were no significant changes between survey years in the NHS and NSMHW. There was no significant change in the relationship between smoking and psychological distress between survey years in any of the survey series.

Conclusion: Social disadvantage may be increasing among current smokers, but the results were inconsistent between survey series, presenting weak evidence that the population of Australian smokers hardened as smoking prevalence declined by approximately 4% over the last decade.

Implications: A greater focus on intensive individual-level tobacco cessation interventions does not appear warranted at this time.

According to the 'hardening hypothesis', persons who continue to smoke cigarettes in the face of strong societal disapproval and discouragement will be more nicotine dependent and less likely to quit than those people who have already quit.¹ This hypothesis predicts that as the population prevalence of smoking decreases, less dependent smokers will quit first, leaving behind a higher proportion of more dependent and 'low-probability quitters'¹ (including 'hardcore' smokers) in the smoking population. Some Australian tobacco control advocates have endorsed this view that the population of Australian smokers is becoming "harder to treat".²

Pierce et al.³ defined low-probability quitters as those characterised by high addiction levels (more than 15 cigarettes per day), no recent history of quitting (for at least 24 hours in the past year) and no intention of quitting in the next six months. Within this group, are a sub-set of 'hardcore' smokers who say that they "never expected to quit". The proportion of smokers that are hardcore using this definition is low in English-speaking countries, with 5.2% of Californian smokers in 1996,¹ 13.7% of the US smoking population⁴ and 16% of English smokers.⁵ The small number of these smokers does not prevent a continuing decline in population smoking prevalence. The three times higher prevalence of low-probability quitters (hardened smokers) poses a more substantial challenge to reducing the population prevalence of smoking (14.9% of Californian smokers in 1996). If the proportion of hardened smokers does increase over time, then more intensive individual-level tobacco cessation interventions may be needed to reduce the population smoking prevalence.⁶

Critics of the hardening hypotheses⁷ point to the declining mean number of cigarettes that smokers smoke each day in both the US⁸ and Australia and also the decline in the percentage of smokers who smoke daily or smoke within 30 minutes of waking.^{7,8} Warner and Burns⁶ have suggested other explanations for these observations. Smokers who do not quit would smoke fewer cigarettes per day and more people smoke less than daily because of decreasing opportunities to smoke. The contemporary population of 'quitters-in-waiting' in the US has much higher numbers of poorly educated and blue-collar smokers than was the case in the 1960s.⁶

More socially advantaged people are less likely to start smoking and more likely to quit if they do smoke.⁹ Socially disadvantaged smokers may experience more difficulty quitting because more of their friends and family smoke, fewer try to quit^{6,10} and they tend to be heavier smokers.^{11,12} Abstract notions of disease risk and appeals to forgo the short-term pleasures of smoking in exchange for longer-term health benefits may not be as compelling to people with more limited education and life options.^{6,13} Less educated and blue-collar populations have also made fewer quit attempts and are less likely to intend to quit.^{12,13}

Smokers with a comorbid mental health or substance abuse disorder are also less likely to have quit smoking. High levels of comorbidity between smoking, substance use, anxiety and affective disorders and psychosis have been found in clinical populations,¹⁴ the general population in Australia¹⁵ and internationally.^{16,17} Longitudinal studies¹⁸ suggest that persons who are anxious and depressed are more likely to smoke, and smokers with mental disorders find it more difficult to quit,¹⁹ although there are some exceptions.²⁰

If the 'hardening hypothesis' is correct, Australians who still currently smoke cigarettes will be more nicotine dependent and have higher levels of psychological distress that makes quitting more difficult.²¹ If the smoker population is hardening, then symptoms of depressive and

anxiety disorders, such as psychological distress, will also become more prevalent over time in current (and continuing) smokers.²²

While social disparities in smoking rates in Australia are substantial,²³ it is unclear whether the social gradient in smoking has increased over the last decade. One analysis of smoking disparities in the 1989–90 and 2001 Australian National Health Surveys²⁴ found an increasing social gradient of smoking only in males. Among males, the decline in smoking prevalence was greater in the most socioeconomically advantaged quintile than in the least advantaged quintile. No further analyses of changes in the social gradient of smoking in Australia have been undertaken.

This paper examines whether there has been increased hardening in Australian smokers over the past decade as reflected in an increased prevalence over time of psychological distress and social disadvantage among current smokers. To address this question, we used all available survey data for the period 1997 to 2010 from three national population based surveys to assess whether any such relationships were consistently replicated. These surveys included: 1) the 1997 and 2007 National Survey of Mental Health and Well-Being (NSMHW); 2) the 2001, 2004–05 and 2007–08 National Health Surveys (NHS); and 3) the 2001, 2004 and 2010 National Drug Strategy Household Surveys (NDSHS).

Method

Surveys

National Health Survey

The 2001, 2004–05 and 2007–08 NHS data comprised representative samples of n=17,725, n=19,501 and n=15,779 Australians aged 18 years or older living in private dwellings. Data were collected by trained ABS interviewers who conducted personal interviews at selected private dwellings. The response rates were 92% in 2001, 89.4% in 2004–05 and 90.6% in 2007–08. Further information on the sampling design and methods for these three streams of the NHS are available elsewhere.^{25,26}

National Survey of Mental Health and Well-Being

Both the 1997 and 2007 NSMHW interviewed multistage probability samples of English-speaking Australians living in private dwellings. The 1997 and 2007 samples comprised 10,641 and 8,463 persons respectively, aged 18 to 85 years. Data were collected by trained ABS interviewers who conducted personal interviews at selected private dwellings using a Computer-Assisted Interview questionnaire. The response rates were 78% in 1997 and 60% in 2007. Further information on the sampling design and methods for the 1997 and 2007 NSMHW are published elsewhere.^{27–29}

National Drug Strategy Household Survey

The 2001, 2004, 2007 and 2010 NDSHS data comprised multistage stratified samples of n=25,263, n=26,730, n=21,846 and n=24,972 Australians aged 18 years or older living in private dwellings. The majority of the survey data were collected using ‘drop and collect’ self-completed questionnaires. These were augmented by some face-to-face interviews and CATI interviews in 2001. The response rates were 50% in 2001, 46% in 2004, 54% in 2007 and 51%

in 2010. Further information on the sampling design and methods for these three years of the NDSHS are available elsewhere.^{30–32}

Measures

Smoking status: Participants were asked whether they currently smoked tobacco and, if so, how often. We classified participants as daily smokers, non-daily smokers (those who smoke weekly or less than weekly) and non-smokers (ex-smokers and never smokers). Non-daily smokers were excluded from our regression analyses because they are unlikely to be hardcore smokers.

Psychological distress was measured using the Kessler 10 (K10), a 10-item scale which assesses symptoms of nervousness, restlessness and depression. Higher scores on the K10 indicate higher levels of psychological distress.³³ This scale has good psychometric properties and good correlation with DSM-IV criteria for affective and anxiety disorders.³⁴ Respondents who scored 10 to 15 were coded as having low distress, those between 16 and 29 had medium distress, and those between 30 and 50 had high distress.³⁵ The Kessler 10 scale was not included in the 2001 NDSHS and the NDSHS 2004 data was used for analyses.

Socioeconomic disadvantage: The NHS, NMHS and the 2001 NDSHS used an area-based index of relative socioeconomic disadvantage (IRSD) that was grouped into quintiles. The 2004 and 2010 NDSHS used the index of relative socioeconomic advantage and disadvantage (IRAD) grouped as quintiles. Both indices are compiled by the Australian Bureau of Statistics and take into consideration income, education, employment and occupations, within census collection districts. The index of relative socioeconomic disadvantage is derived from 17 items and a high score on this variable equates to a relative lack of disadvantage while a low score equates to high disadvantage. The index of relative socioeconomic advantage and disadvantage is derived from 21 items and high score on this index equates to high advantage (and lack of disadvantage) while a low score equates to high disadvantage. More details on these indices are available elsewhere.³⁶

Data analysis

The proportion of current smokers who were non-daily smokers was calculated for each survey year. The prevalence of psychological distress and socioeconomic disadvantage stratified by smoking status (daily smoker and non-smoker) was calculated for all years of all surveys. All analyses were performed on weighted data to account for the complex sampling design. The weights used for the NDSHS were the person level weights supplied by the data owners (AIHW) to align the sample to the Australian population on age, sex and location. The weights were then scaled to the mean effective sample-size-based key variables in the survey to account for the complex sampling design. Replicate weights provided by the data owners (ABS) were used for the NSMHW and NHS to adjust for the complex sampling design.

Logistic regressions were used to compare differences in the odds of daily smoking according to psychological distress, socioeconomic disadvantage and education in each of the surveys. For regressions using psychological distress as a predictor, low distress was used as the reference category. For regressions using disadvantage as a predictor, the least disadvantaged (fifth) quintile was the reference category. For regressions using education as a predictor, the reference category was a bachelor degree or higher. Age and sex were included as covariates in the analyses as both these factors are correlated with smoking and psychological distress.³⁷

To examine changes over time in the prevalence of daily smoking and quitting smoking according to psychological distress, disadvantage and education, we tested for differences in odds ratios between the latest and earliest surveys for which we had data on these measures (i.e. between 1997 and 2007 for the NSMHW; 2001 and 2008 for the NHS; 2004 and 2010 for NDSHS for psychological distress; and 2001 and 2010 for the NDSHS for disadvantage and education). We also compared 2004 and 2010 NDSHS on disadvantage (see Tables S1 to S3). To do these analyses, we first combined the relevant two years of data for each respective survey and included survey year as a covariate in the analysis. We then computed interaction products between each of the independent variables and survey year and tested whether the addition of the interaction product improved the fit of our models. When the interaction product was statistically significant, we reported the results for the main effects for the model that included the interaction product. Otherwise, we reported the results from the model without the interaction product. Interactions were not tested for the NHS datasets, as some analyses were performed in the ABS Remote Access Data Laboratory (RADL). The NDSHS datasets were analysed in PASW 18.0.1; the NSMHW and 2001 NHS were analysed in SAS version 9.2.; and the 2005 and 2008 NHS datasets were analysed in the RADL using STATA commands.

Results

Daily smoking prevalence fell from 20.2% (95% CI 19.5–20.9%) to 15.9% (95% CI 15.3–16.5%) in the NDSHS, from 22.5% (95% CI 21.7–23.3%) to 18.9% (95% CI 18.0–19.8%) in the NHS and from 23.2% (95% CI 22.2–24.3%) to 18.9% (95% CI 17.5–20.2%) in the NSMHW (Figure 1). The proportion of current smokers who smoke less than daily did not change between survey years for the NDSHS (2001: 15.2%, 95% CI 13.9–16.5%; 2010: 16.0, 95% CI 14.6–17.4%) and the NHS (2001: 7.9%, 95% CI 6.6–9.3%; 2008: 9.0%, 95% CI 7.8.0–10.3%) data series. However, there was an increase in non-daily smokers in the NSMHW (1997: 6.9%, 95% CI 5.1–8.6%; 2007: 17.4%, 95% CI 14.4–20.5%).

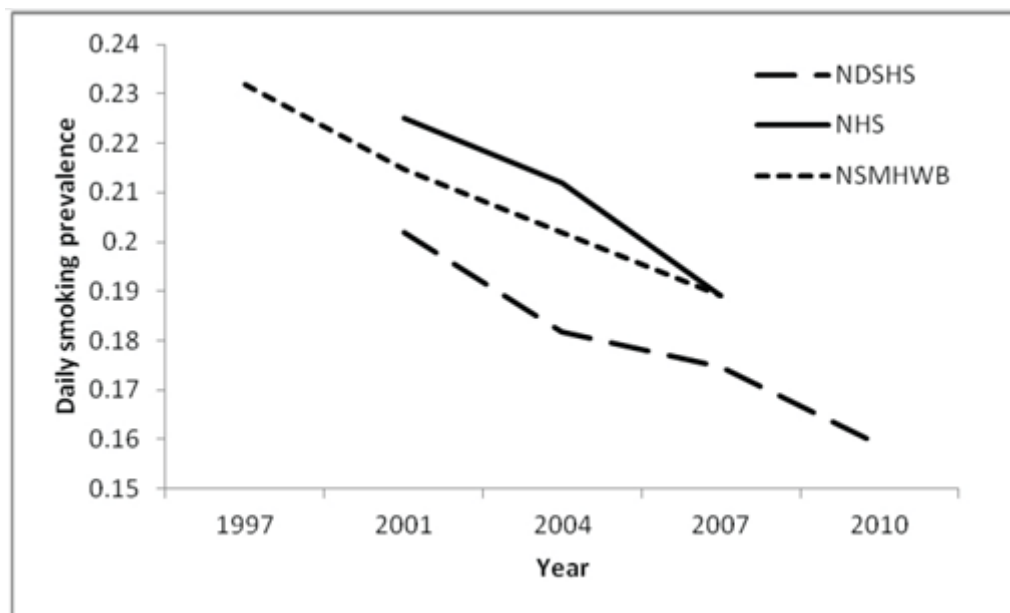


Figure 1. Daily smoking prevalence in Australian population aged 18 years or older according to the National Drug Strategy Household Survey, the National Health Survey and the National Survey of Mental Health and Well-Being.

A greater proportion of smokers than non-smokers lived in the most disadvantaged areas in all survey years (Tables 1 and 2). The percentage of non-smokers living in the most disadvantaged areas remained relatively steady between years in all surveys (Table 1). It was only in the NDSHS that there was a statistically significant increase in the percentage of smokers living in the most disadvantaged areas (Table 2, Table S2, Figures S1 to S3).

Table 1. Prevalence of social disadvantage, psychological distress and education among current non-smokers in the least and most recent surveys for each data series.

	NHS % (95% CI)		NSMHW % (95% CI)		NDSHS % (95% CI)	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Disadvantage 1 (most disadvantaged) 2 3 4 5 (least disadvantaged)	15.6 (14.3–16.9)	15.7 (14.1–17.4)	15.2 (13.8–16.6)	15.1 (13.1–17.2)	16.4 (15.6–17.2)	16.7 (16.0–17.3)
	18.7 (16.3–21.1)	18.8 (17.1–20.7)	18.0 (15.9–20.2)	17.3 (14.8–19.7)	25.6 (24.7–26.5)	17.9 (17.2–18.6)
	19.0 (16.7–21.3)	20.4 (18.8–22.1)	18.7 (16.5–20.8)	20.3 (17.8–22.8)	19.1 (18.3–19.9)	20.3 (19.5–21.0)
	23.3 (21.4–25.2)	20.9 (19.5–22.4)	21.3 (18.6–24.1)	22.6 (19.7–25.4)	14.0 (13.3–14.8)	22.8 (22.0–23.5)
	23.4 (21.3–25.5)	24.2 (22.7–25.9)	26.8 (23.9–29.7)	24.7 (22.4–27.1)	24.9 (24.0–25.8)	22.4 (21.7–23.2)
Highest level of education attained Less than 12 years 12 years (senior school) Vocational certificate Bachelor or higher	34.3 (33.2–35.4)	28.8 (27.9–29.9)	33.1 (31.9–34.3)	27.7 (26.2–29.2)	28.4 (27.5–29.4)	22.6 (21.9–23.4)
	13.8 (13.0–14.6)	17.9 (17.0–18.9)	17.0 (15.0–19.0)	15.2 (14.1–16.2)	15.3 (14.6–16.1)	16.0 (15.3–16.6)
	33.9 (32.9–35)	29.8 (28.6–31.1)	32.6 (30.5–34.6)	34.2 (32.8–35.5)	35.1 (34.1–36.1)	34.5 (33.6–35.3)
	17.9 (16.7–19.2)	23.4 (22.3–24.6)	17.3 (15.9–18.6)	22.9 (22.1–23.8)	21.1 (20.2–21.9)	27.0 (26.1–27.8)
Psychological distress High Moderate Low	2.7 (2.4–3.1)	2.6 (2.3–3.1)	1.4 (1.1–1.8)	2.0 (1.5–2.4)	1.7 (1.4–1.9)	2.0 (1.7–2.2)
	29.8 (28.5–31.1)	27.2 (26.1–28.3)	19.5 (18.4–20.5)	24.4 (23.0–25.9)	27.2 (26.5–28.0)	26.3 (25.5–27.1)
	67.5 (66.2–68.7)	70.2 (69.1–71.3)	79.1 (77.9–80.3)	73.6 (72.1–75.1)	71.1 (70.3–71.9)	71.7 (70.9–72.5)

Year 1=2001 and Year 2=2007/8 for NHS; Year 1=1997 and Year 2=2007 for NSMHW; Year 1=2001 for Disadvantage and Education and 2004 for Psychological distress in the NDSHS and Year 2=2010 in the NDSHS

Table 2. Prevalence of social disadvantage, psychological distress and education among current daily smokers in the least and most recent surveys for each data series.

	NHS % (95% CI)		NSMHW % (95% CI)		NDSHS % (95% CI)	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Disadvantage 1 (most disadvantaged) 2 3 4 5 (least disadvantaged)	23.7 (21.1–26.3)	26.8 (23.9–30.0)	21.9 (19.2–24.6)	23.3 (19.5–27.2)	20.3 (18.7–21.9)	26.9 (25.1–28.7)
	22.0 (19.6–24.4)	21.9 (19.1–25.0)	20.4 (17.7–23.2)	22.5 (18.7–26.3)	29.4 (27.6–31.3)	22.2 (20.5–23.9)
	19.3 (16.7–22.0)	21.5 (19.1–24.0)	18.8 (15.1–22.4)	20.3 (17.0–23.6)	19.6 (18.0–21.2)	19.3 (17.7–20.9)
	21.0 (18.8–23.2)	16.4 (14.3–18.8)	19.4 (16.5–22.3)	19.1 (15.5–22.6)	14.3 (12.9–15.7)	18.7 (17.1–20.3)
	13.9 (12.1–15.5)	13.4 (11.6–15.2)	19.6 (16.3–22.9)	14.8 (11.2–18.4)	16.4 (14.9–17.9)	12.9 (11.5–14.3)

Table 1. Prevalence of social disadvantage, psychological distress and education among current non-smokers in the least and most recent surveys for each data series.

	NHS % (95% CI)		NSMHW % (95% CI)		NDSHS % (95% CI)	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
	15.8)	15.5)	22.8)	18.4)	17.9)	14.3)
Highest level of education attained	43.5 (41.6–45.4)	40.1 (38.1–42.2)	43.7 (40.9–46.4)	39.3 (35.4–43.2)	36.8 (34.9–38.8)	32.9 (30.9–34.9)
Less than 12 years	12 (13.1–15.3)	12 (12.6–16.6)	12 (15.6–18.7)	12 (11.1–16.8)	12 (12.7–15.5)	12 (13.2–16.1)
years (senior school)	34.0 (32.4–35.7)	36.3 (34.2–38.5)	32.2 (29.1–35.3)	36.2 (33.0–39.4)	39.8 (37.8–41.8)	42.5 (40.4–44.6)
Vocational certificate	8.3 (7.2–9.4)	9.1 (8.0–10.4)	6.9 (4.9–8.9)	10.6 (8.1–13.2)	9.3 (8.1–10.5)	10.0 (8.7–11.2)
Bachelor or higher	6.1 (5.3–6.8)	7.2 (6.1–8.5)	4.3 (3.5–5.1)	4.9 (3.5–6.2)	5.0 (4.2–5.8)	4.8 (3.9–5.7)
Psychological distress	38.5 (36.8–40.3)	36.5 (34.1–38.9)	26.5 (21.2–31.8)	33.3 (29.9–36.7)	36.5 (34.7–38.2)	35.7 (33.7–37.7)
High Moderate Low	55.4 (53.6–57.1)	56.4 (53.7–59.0)	69.2 (63.6–74.8)	61.9 (58.3–65.4)	58.6 (56.8–60.4)	59.5 (57.5–61.5)

Year 1=2001 and Year 2=2007/8 for NHS; Year 1=1997 and Year 2=2007 for NSMHW; Year 1=2001 for Disadvantage and Education and 2004 for Psychological distress in the NDSHS and Year 2=2010 in the NDSHS; All analyses included age and sex as co-variates.

The proportion of non-smokers with less than 12 years of schooling decreased in all survey years of the three data series (Table 1). However, the proportion of smokers with less than 12 years of schooling remained relatively stable in all data series (Table 2). The proportion non-smokers with university level education (bachelor degree or higher) increased between survey years for all data series, but the proportion of smokers with a university level education did not change between survey years (Tables 1 and 2, Figures S4 to S6).

High psychological distress was more common among smokers than non-smokers in all years of all surveys and this remained relatively stable between survey years for all data series (Tables 1 and 2, Figures S7 to S9).

The relationship between living in the most disadvantaged areas and smoking strengthened between 2001 and 2010 in the NDSHS, but there were no significant changes in the NHS and NSMHW, or between 2004 and 2010 in the NDSHS (Table 3, Table S3). There was no significant change in the relationship between smoking and education, except in the NDSHS, for having completed 12 years of schooling (Table 3). There was also no significant change in the relationship between smoking and psychological distress between survey years for all data series.

Table 3. Relationship between social disadvantage, psychological distress and education with current daily smoking (compared to current non-smokers) in the most recent surveys for each data series adjusted for age and sex.

	NHS Odds Ratio (95% CI)		NSMHW Odds Ratio (95% CI)		NDSHS Odds Ratio (95% CI)	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Disadvantage^a						
1 (most disadvantaged)	2.92 (2.47–3.45)	3.20 (2.62–3.92)	2.14 (1.70–2.68)	2.68 (1.98–3.64)	1.88 (1.62–2.19)	2.99 (2.57–3.48)
2	2.11 (1.82–2.45)	2.12 (1.75–2.57)	1.65 (1.33–2.04)	2.34 (1.72–3.18)	1.75 (1.53–2.01)	2.22 (1.90–2.59)
3	1.77 (1.58–2.00)	1.91 (1.56–2.35)	1.43 (1.01–2.03)	1.69 (1.31–2.19)	1.54 (1.33–1.79)	1.69 (1.44–1.98)
4	1.54 (1.32–1.80)	1.37 (1.13–1.66)	1.29 (1.08–1.53)	1.37 (1.00–1.86)	1.52 (1.29–1.78)	1.42 (1.21–1.67)
5 (least disadvantaged)	1.00	1.00	1.00	1.00	1.00	1.00
Highest level of education attained^a						
Less than 12 years	4.16 (3.54–4.89)	4.99 (4.16–5.98)	4.49 (3.40–5.92)	4.73 (3.38–6.64)	3.78 (3.21–4.45)	5.64 (4.78–6.64)
12 years (senior school)	2.06 (1.78–2.39)	1.76 (1.35–2.29)	2.57 (1.86–3.55)	1.98 (1.37–2.85)	1.83 (1.51–2.21)	2.15 (1.79–2.59)
Vocational certificate	2.45 (2.09–2.86)	3.36 (2.83–4.00)	2.75 (1.85–4.09)	2.57 (1.91–3.45)	2.77 (2.36–3.25)	3.68 (3.14–4.30)
Bachelor or higher	1.00	1.00	1.00	1.00	1.00	1.00
Psychological distress^a						
High	2.80 (2.31–3.38)	3.63 (2.93–4.48)	3.66 (2.58–5.18)	3.02 (1.99–4.59)	3.34 (2.68–4.16)	2.74 (2.16–3.48)
Moderate	1.51 (1.37–1.66)	1.65 (1.46–1.86)	1.48 (1.17–1.88)	1.54 (1.29–1.84)	1.51 (1.39–1.65)	1.55 (1.40–1.70)
Low	1.00	1.00	1.00	1.00	1.00	1.00

1. Year 1=2001 and Year 2=2007/8 for NHS; Year 1=1997 and Year 2=2007 for NSMHW; Year 1=2001 for Disadvantage and Education and 2004 for Psychological distress in the NDSHS and Year 2=2010 in the NDSHS a Significant interaction with year for NDSHS, interaction product included in model and main effect reported in table.

Discussion

Our study used data from two time-points with 7–10 year intervals from three series of large representative Australian population-based surveys to assess predictions of the hardening hypothesis, specifically whether the proportion of smokers who are socially disadvantaged, have lower education and/or are psychological distressed has increased, as smoking prevalence has declined. There were strong cross-sectional relationships between smoking

and social disadvantage, lower education and psychological distress in all data series and in each survey year. However, there were no consistent increases in the relationship between these measures and smoking over time. There was no evidence that psychological distress increased among smokers in any of the data series, and the relationship between smoking and social disadvantage only strengthened between 2001 and 2010 in the NDSHS. There was no change in this relationship between 2004 and 2010 of the NDSHS. Therefore, the difference could be due to use of the IRSD in 2001 and IRAD in 2010 to measure social disadvantage if the IRAD classifies more smokers being into the lowest quintile in 2001. If hardening of smokers had occurred we would expect to see much more consistent increases in the relationships between smoking and these variables between the earliest and most recent surveys in each data series. There was also no increase in the proportion of current smokers who were daily smokers over the time periods examined.

Our findings are consistent with a recent study in Norway which found no evidence that the prevalence of hardcore smoking changed in the smoker population, based on quitting history and quit intentions.³⁸ Similar to our results, this study found no evidence of an increasing association over time between low education and smoking in the Norwegian population. Our findings conflict with those of Fagerström and Furberg who found a significant inverse correlation between a measure of nicotine dependence and smoking prevalence across countries,³⁹ that countries with lower prevalence of smoking had greater proportions of highly dependent smokers. Our analyses found a significant increase in the proportion of smokers residing in the most disadvantaged areas in the one data series covering the period of 2001 to 2010. The most recent surveys in the remaining two data series were conducted in 2007–08.

Reducing the social gradient in smoking remains an important policy goal because smoking is an important contributor to the health gap between the most and least disadvantaged in society.⁴⁰ Smoking among those in disadvantaged circumstances increases the risk of premature death and disease, increases the incidence of financial stress⁴¹ and helps to perpetuate the intergenerational transfer of poverty.²³

Limitations

Our comparisons between the three series of Australian population-based surveys used slightly different time periods. These differences may explain the slight inconsistencies between data series on some measures, such as social disadvantage. Alternatively, they may indicate differences in the demographics of final samples obtained, even after adjustment for the complex sampling designs. Our failure to find evidence of hardening using these measures is unlikely to be due to lack of statistical power, as all surveys utilised large sample sizes that ranged from 8,463 to 26,730. Standard measures of smoking – social disadvantage, education and psychological distress – were used with a high degree of consistency across survey years. The decline of smoking among those with less than year 12 education may be less a reflection of declining smoking among those with the most limited education as a decline in the proportion of young people who fail to finish year 12 (so that increasingly those with less years of formal education are women born pre-1950s among whom smoking rates have always been very low).⁴²

Because the surveys were not designed to test the hardening hypothesis, we were limited in the measures available for analysis. It would have been more desirable to measure changes in

nicotine dependence (as defined, for instance, by time after waking to first cigarette and cigarettes per day), past quit attempts and future quitting intentions.⁴³

Conclusions

We found little evidence that the population of Australian smokers is hardening as the prevalence of smoking has declined. Important aspects of hardening including nicotine dependency and quitting history and future aspirations were not examined in this study. However there were no consistent increases in the relationship between smoking and social disadvantage, low education and psychological distress in these data series over the decade examined, during which smoking prevalence declined by approximately 4%. As countries such as Australia and New Zealand contemplate 'endgame' strategies to reduce smoking prevalence to near zero, these results suggest that a greater focus on intensive individual-level tobacco cessation interventions rather than population-wide approaches does not appear warranted at this time.

Summary

What is already known on this subject?

According to the hardening hypothesis, as smoking prevalence declines, smokers who find cessation easy will quit first, leaving smokers who find quitting more difficult.

What does this study add?

- This study examined trends in the relationship between smoking and three important factors associated with a lower chance of quitting (social disadvantage, low education and psychological distress) in three large representative national series of cross-sectional surveys over a decade.
- We did not find consistent evidence that the relationship between smoking and these factors strengthened across the surveys, despite smoking prevalence declining by 4%.
- This is evidence against the proposition that hardening has occurred among Australian smokers.

Acknowledgements

CG is funded by an Australian National Health and Medical Research Council Postdoctoral Research Training Fellowship. WH is funded by an Australian National Health and Medical Research Council Australia Fellowship. The funder had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication. The confidentialised unit record file for the 2001, 2004, 2007 and 2010 National Drug Strategy Household Surveys were provided by the Australian Institute of Health and Welfare, the Department of Health and Ageing and the Australian Social Science Data Archive; however, they bear no responsibility for the analyses presented within this publication or the interpretation of them. The confidentialised unit record file for the 2001, 2004/5 and 2007/8 National Health Surveys were provided by the Australian Bureau of Statistics; however, they bear no responsibility for the analyses presented within this publication or the interpretation of them.

References

- 1 Emery S, Gilpin EA, Ake C, Farkas AJ, Pierce JP. Characterizing and identifying “hard-core” smokers: implications for further reducing smoking prevalence. *Am J Public Health*. 2000;90:387–94.
- 2 Wilcox N, Peters M, Van Asperen P, Harrison D, Bittoun R. *Improving Smoking Cessation Interventions in the Clinical Setting: A Proposal to NSW Health [Internet]*. Sydney (AUST) : NSW Agency for Clinical Innovation; 2009.
- 3 Pierce JP, Farkas AJ, Gilpin EA. Beyond stages of change: the quitting continuum measures progress towards successful smoking cessation. *Addiction*. 1998;92:277–86.
- 4 Augustson EM, Marcus SE. Use of the Current Population Survey to characterize subpopulations of continued smokers: A national perspective on the “hardcore” smoker phenomenon. *Nicotine Tob Res*. 2004;6:621–9.
- 5 Jarvis MJ, Wardle J, Waller J, Owen L. Prevalence of hardcore smoking in England, and associated attitudes and beliefs: cross sectional study. *BMJ*. 2003;326:1061.
- 6 Warner KE, Burns DM. Hardening and the hard-core smoker: concepts, evidence, and implications. *Nicotine Tob Res*. 2003;5:37–48.
- 7 Chapman S. The inverse impact law of smoking cessation. *Lancet*. 2009;373:701–3.
- 8 Giovino GA, Chaloupka FJ, Hartman AM, Gerlach JK, Chriqui J, Orleans CT, et al. *Cigarette Smoking Prevalence and Policies in the 50 States: An Era of Change — The Robert Wood Johnson Foundation ImpacTeen Tobacco Chartbook*. Buffalo (NY) : University at Buffalo, State University of New York; 2009.
- 9 Gilman SE, Abrams DB, Buka SL. Socioeconomic status over the life course and stages of cigarette use: initiation, regular use, and cessation. *J Epidemiol Community Health*. 2003;57:802–8.
- 10 Christakis NA, Fowler JH. The Collective Dynamics of Smoking in a Large Social Network. *N Engl J Med*. 2008;358:2249–58.
- 11 Bobak M, Jarvis MJ, Skodovac Z, Marmot M. Smoke intake among smokers is higher in lower socioeconomic groups. *Tob Control*. 2000;9:310–2.
- 12 Reid JL, Hammond D, Boudreau C, Fong GT, Siahpush M, ITC Collaboration. Socioeconomic disparities in quit intentions, quit attempts, and smoking abstinence among smokers in four western countries: Findings from the International Tobacco Control Four Country Survey. *Nicotine Tob Res*. 2010;12:S20–S33.
- 13 Martin LT, Haas A, Schonlau M, Derosé KP, Rosenfeld L, Rudd R, et al. Which literacy skills are associated with smoking? *J Epidemiol Community Health*. 2012;66(2):189–92.
- 14 Jochelson J, Majrowski B. *Clearing the Air. Debating Smoke-free Policies in Psychiatric Units*. London (UK) : King's Fund; 2006.
- 15 Mathews R, Hall W, Gartner C. Is there evidence of “hardening” among Australian smokers between 1997 and 2007? Analyses of the Australian National Surveys of Mental Health and Well-being. *Aust N Z J Psychiatry*. 2010;44:1132–6.

- 16 Degenhardt L, Hall W. *The relationship between tobacco use, substance-use disorders and mental health: results from the National Survey of Mental Health and Well-being*. *Nicotine Tob Res*. 2001;3:225–34.
- 17 Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. *Smoking and mental illness: A population-based prevalence study*. *JAMA*. 2000;284:2606–10.
- 18 Leung J, Gartner C, Hall W, Lucke J, Dobson A. *A longitudinal study of the bi-directional relationship between tobacco smoking and psychological distress in a community sample of young Australian women*. *Psychol Med*. 2012;42(6):1273–82.
- 19 Ziedonis D, Hitsman B, Beckham JC, Zvolensky M, Adler LE, Audrain-McGovern J, et al. *Tobacco use and cessation in psychiatric disorders: National Institute of Mental Health report*. *Nicotine Tob Res*. 2008;10:1691–715.
- 20 El-Guebaly N, Cathcart J, Currie S, Brown D, Gloster S. *Smoking cessation approaches for persons with mental illness or addictive disorders*. *Psychol Serv*. 2002;53:1166–70.
- 21 Johnson EO, Breslau N. *Is the association of smoking and depression a recent phenomenon?* *Nicotine Tob Res*. 2006;8:257–62.
- 22 Khuder SA, Dayal HH, Mutgi AB. *Age at smoking onset and its effect on smoking cessation*. *Addict Behav*. 1999;24:673–7.
- 23 Scollo M. *Smoking and social disadvantage*. Chapter 9. In: Scollo M, Winstanley M, editors. *Tobacco in Australia: Facts and Issues*. Melbourne (AUST) : Cancer Council Victoria; 2008.
- 24 Najman J, Toloo G, Sisikind V. *Socioeconomic disadvantage and changes in health risk behaviours in Australia: 1989–90 to 2001*. *Bull World Health Organ*. 2006;84:976–84.
- 25 Australian Bureau of Statistics. *National Health Survey 2001, Technical Report*. Canberra (AUST) : ABS; 2002.
- 26 Australian Bureau of Statistics. *National Health Survey 2007–08 Technical Report*. Canberra (AUST) : ABS; 2009.
- 27 Australian Bureau of Statistics. *Mental Health and Wellbeing: Profile of Adults, Australia 1997*. Canberra (AUST) : ABS; 1998.
- 28 Slade T, Johnston A, Oakley Browne M, Andrews G, Whiteford H. *2007 National Survey of Mental Health and Wellbeing: methods and key findings*. *Aust N Z J Psychiatry*. 2009;43:594–605.
- 29 Australian Bureau of Statistics. *National Survey of Mental Health and Wellbeing: Users' Guide*. Catalogue No.: 4327.0. Canberra (AUST) : ABS; 2008.
- 30 Roy Morgan Research. *National Drug Strategy Household Survey 2001 Technical Report*. Melbourne (AUST) : Australian Institute of Health and Welfare; 2002.
- 31 Roy Morgan Research. *National Drug Strategy Household Survey 2005 Technical Report*. Melbourne (AUST) : Australian Institute of Health and Welfare; 2005.
- 32 Roy Morgan Research. *National Drug Strategy Household Survey 2010 Final Technical Report*. Canberra (AUST) : Australian Institute of Health and Welfare; 2011.

- 33 Kessler R. *Kessler Psychological Distress Scale (K10)*. Boston (MA) : Harvard Medical School; 1996.
- 34 Furukawa TA, Kessler RC, Slade T, Andrews G. *The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being*. *Psychol Med*. 2003;33:357–62.
- 35 Andrews G, Slade T. *Interpreting scores on the Kessler Psychological Distress Scale (K10)*. *Aust N Z J Public Health*. 2001;25:494–7.
- 36 Australian Bureau of Statistics. 2039.0 — *Information Paper: An Introduction to Socio-Economic Indexes for Areas (SEIFA)*. Canberra (AUST) : ABS; 2006.
- 37 Australian Bureau of Statistics. 4364.0 — *National Health Survey 2007–08: Summary of Results*. Canberra (AUST) : ABS; 2009.
- 38 Lund M, Lund KE, Kvaavik E. *Hardcore Smokers in Norway 1996–2009*. *Nicotine Tob Res*. 2011;13:1132–9.
- 39 Fagerström K, Furberg H. *A comparison of the Fagerström Test for Nicotine Dependence and smoking prevalence across countries* *Addiction*. 2008;103:841–5.
- 40 Turrell G, Mathers C. *Socio-economic status and health in Australia*. *Med J Aust*. 2000;172:434–8.
- 41 Siahpush M, Borland R, Scollo M. *Smoking and financial stress*. *Tob Control*. 2003;12:60–6.
- 42 Hill D. *Australian patterns of tobacco smoking in 1986*. *Med J Aust*. 1988;149: 6–10.
- 43 Costa ML, Cohen JE, Chaiton MO, Ip D, McDonald P, Ferrence R. *“Hardcore” definitions and their application to a population-based sample of smokers*. *Nicotine Tob Res*. 2010;12:860–4.