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ORIGINAL ARTICLE

A longitudinal study of the bi-directional relationship between tobacco smoking and psychological distress in a community sample of young Australian women

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Background. Tobacco smoking and poor mental health are both prevalent and detrimental health problems in young women. The temporal relationship between the two variables is unclear. We investigated the prospective bi-directional relationship between smoking and mental health over 13 years.

Method. Participants were a randomly selected community sample of 10 012 young women with no experience of pregnancy, aged 18–23 years at baseline (1996) from the Australian Longitudinal Study on Women's Health. Follow-up surveys over 13 years were completed in 2000, 2003, 2006 and 2009, allowing for five waves of data. Measures included self-reported smoking and mental health measured by the Mental Health Index from the 36-item short-form health questionnaire and the 10-item Center for Epidemiologic Studies Depression Scale. Sociodemographic control variables included marital status, education level and employment status.

Results. A strong cross-sectional dose–response relationship between smoking and poor mental health was found at each wave [odds ratio (OR) 1.41, 95% confidence intervals (CI) 1.17–1.70 to OR 2.27, 95% CI 1.82–2.81]. Longitudinal results showed that women who smoked had 1.21 (95% CI 1.06–1.39) to 1.62 (95% CI 1.24–2.11) times higher odds of having poor mental health at subsequent waves. Women with poor mental health had 1.12 (95% CI 1.17–1.20) to 2.11 (95% CI 1.68–2.65) times higher odds of smoking at subsequent waves. These results held after adjusting for mental health history and smoking history and sociodemographic factors. Correlation analysis and structural equation modelling results were consistent in showing that both directions of the relationship were statistically significant.

Conclusions. The association between poor mental health and smoking in young women appeared to be bi-directional.

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Key words: Anxiety, depression, mental health, psychological distress, smoking.

Introduction

Tobacco smoking has a strong association with psychological distress (McNeill, 2001; Fergusson *et al*. 2003; Leung *et al*. 2010) and both depression and smoking-related diseases are expected to be among the largest contributors to the global burden of disease in the future (Lopez *et al*. 2006). There are age and gender differences in both smoking behaviour and mental health status (Henderson *et al*. 1998; Jorm, 2000; Gartner & Hall, 2009). Anxiety and depression are most common among younger people and in women. Women who smoke are at additional gender-specific risks of adverse reproductive outcomes, such as menstrual complications, miscarriages, premenstrual tension, irregular and heavy periods, severe period pain, decreased fertility and early onset of menopause (Kline *et al*. 1989; Centers for Disease Control and Prevention, 2001).

Tobacco smoking may contribute to the worsening of mental health and poor mental health may contribute to smoking (Breslau *et al*. 1993; Fergusson *et al*. 2003; Korhonen *et al*. 2007), both of which impair physical well-being and reduce quality of life (Huppert & Whittington, 1995; Grant *et al*. 2005; Rasul *et al*. 2007). The causal direction of the association between smoking and mental health is uncertain and few studies have examined this complex relationship specifically in a population-based sample of young women.

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An Australian study utilized a case–control study and a 10-year follow-up retrospective cohort study to examine the relationship between smoking and depression in sample of women aged 20–84 years of age (Pasco *et al*. 2008). The case–control results showed that compared with non-smokers, smokers had 1.46 times higher odds [95% confidence intervals (CI) 1.03–2.07] of meeting criteria for depression, after adjusting for sociodemographic, physical and behavioural factors. The retrospective cohort results showed that 15% of smokers developed depression, whereas only 7% of non-smokers did so. While this study suggested that smoking may lead to depression, data were not collected to assess whether depression might lead to smoking. In addition, the authors acknowledged that the small sample size was a limitation in the longitudinal analysis.

Another recent longitudinal study examined the temporal relationship between cigarette smoking and depression in a New Zealand birth cohort using data from participants at 18, 21 and 25 years of age (Boden *et al*. 2010). In that study, depressive symptoms according to DSM-IV criteria were measured using the Composite International Diagnostic Interview. Smoking variables measured included DSM-IV nicotine dependence and cigarette intake frequency. The bi-directional relationship between the smoking variables and depression was examined using structural equation models. Results suggested that nicotine dependence was more likely to lead to depression ($B=0.18$, S.E. $=0.05$, $p<0.001$) than depression was to lead to nicotine dependence ($B=0.05$, S.E. $=0.02$, $p<0.01$). The authors conceded that their findings were not definitive. Females and males have different prevalence of smoking and depression, but gender differences were not examined. Also, the participants were at a reproductive age and pregnant women may change their smoking behaviour. Also, depressive symptoms may be affected by the reproductive cycle.

To examine the question of bi-directionality further, we investigated the temporal relationship between tobacco smoking and mental health using longitudinal data from a national representative sample of young Australian women. We used multiple waves of data and excluded women with any experience of pregnancy. We hypothesized that there would be a bi-directional relationship in which smoking was associated with worsening mental health and poor mental health was associated with increased smoking.

Method

Data source

Data were from five waves of the Australian Longitudinal Study on Women's Health (ALSWH; Lee *et al*. 2005) for women who were aged 18–23 years in 1996. This Australian representative sample included women randomly selected from the Australian national health insurance database (Medicare), which includes all citizens and permanent residents. The study uses mailed questionnaires to collect self-report data on health and related variables. The study is funded by the Australian Government Department of Health and Ageing and has ethics approval from the University of Queensland and the University of Newcastle. Further details of the study can be found at www.alswh.org.au.

Participants

Potential participants were 14 247 young women born in 1973–1978 who responded at wave 1. Respondents in the follow-up waves were $n=9688$, 9081, 9145 and 8200 at waves 2, 3, 4 and 5, respectively. Women who reported any pregnancy experiences were excluded due to the complex relationship that pregnancy may have in reducing smoking (by increasing quit attempts) and increasing depression (via postnatal depression) (Park *et al*. 2009). This exclusion reduced the number of respondents substantially (see Fig. 1). Additionally, women with missing data on smoking or mental health variables were excluded. The final sample size in the current analysis were $n=10$ 012, 6576, 4801, 3443 and 2191, at waves 1–5, respectively.

Measures

Tobacco smoking measures

Smoking status at each wave was categorized as: 1 = 'never smoker', for those who had never smoked >100 cigarettes in their lifetime; 2 = 'ex-smoker', for those who had smoked >100 cigarettes in their lifetime but were not smoking at the time of the survey; 3 = 'smoke <10 cigarettes per day (CPD)', for current smokers who smoke <10 CPD; 4 = 'smoke 10–19 CPD', for current smokers who smoke 10–19 CPD; 5 = 'smoke ⩾20 CPD', for current smokers who smoke ⩾20 CPD. This order was used when we analysed smoking as an ordinal categorical variable.

Mental Health Index

The Mental Health Index (MHI) is a scale derived from five symptoms of psychological distress included in the 36-item short-form survey of health-related quality of life (Ware & Sherbourne, 1992). Respondents were asked for each of the five symptoms the response that came closest to the way they had been feeling during the past 4 weeks (e.g. 'Have you felt down' with response options ranging from 0 = 'all of the time' to 5 = 'none of the time'). Items were summed to give a

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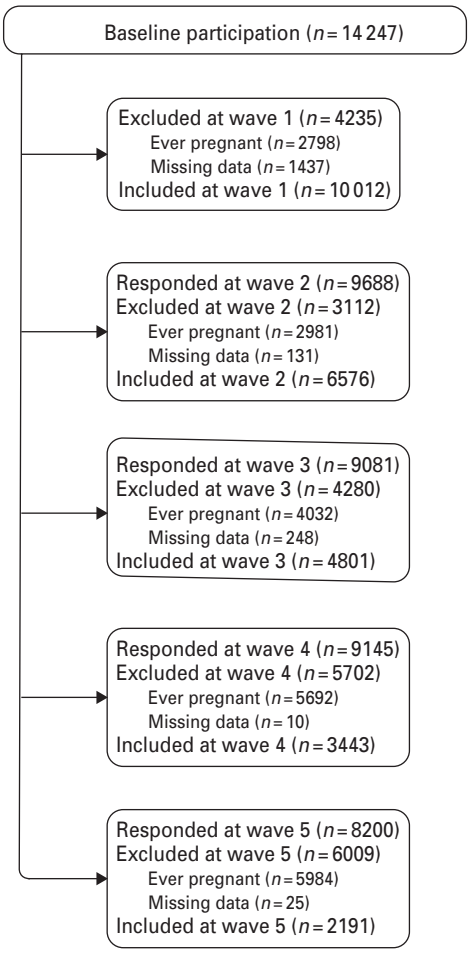

Fig. 1. Flowchart of participants meeting the inclusion criteria. Participants who had ever been pregnant or who had missing data for the smoking or mental health variables were excluded.

score between 0 and 25 that was rescaled to a score between 0 and100 with higher scores indicating better mental health (Ware & Sherbourne, 1992). We analysed MHI as both a continuous measure and a dichotomous variable by using MHI $\leqslant 52$ to define poor mental health. This cut-off score has been assessed to be a valid indicator of poor mental health (Berwick *et al*. 1991; Silveira *et al*. 2005).

Center for Epidemiologic Studies Depression Scale

The Center for Epidemiologic Studies Depression Scale (CESD) is a 10-item depression scale that has been widely used in population surveys (Andresen *et al*. 1994). Participants were asked to indicate the extent to which they have been feeling depressed during the last week (e.g. 'I felt depressed', with a response scale from 0 = 'rarely or none of the time' to 3 = 'most or all of the time'). The CESD has good validity, with higher scores associated with clinical diagnosis of depressive disorders in a range of populations (Breslau, 1985; Caracciolo & Giaquinto, 2002; Haringsma *et al*. 2004; Stahl *et al*. 2008). Reliability of the CESD has been assessed to be strong (Cronbach's $\alpha > 0.85$, test–retest reliability > 0.50; Radloff, 1977; Andresen *et al*. 1994). We analysed CESD as a continuous measure and a dichotomous variable using a cut-off score of $\geqslant 10$ to define poor mental health (following Andresen *et al*. 1994). The CESD was measured from wave 2 onwards.

Sociodemographic measures

We included the sociodemographic variables of education level, marital status and employment status at each wave as potential confounders. The highest level of education completed was categorized as 'high school or below', 'trade, certificate or diploma' and 'university degree or above'. Employment status was categorized as 'work or study' and 'no work or study'. Marital status was categorized as 'partnered' and 'not partnered'.

Analysis

Cross-sectional analysis

We examined the cross-sectional associations between smoking status and mental health status at each wave by estimating the proportion of poor mental health status by smoking status. At each wave, we tested for dose–response trends using a logit model that adjusted for sociodemographic variables, with smoking status as an ordinal categorical variable. Data from all five waves were used simultaneously in a generalized estimating equations model to estimate the overall associations between smoking and MHI and CESD (dichotomized).

Longitudinal analysis

Generalized estimating equations were also used to conduct the longitudinal analyses for each direction of the hypothesis separately. First, we examined whether smoking at waves 1, 2, 3 and 4 predicted mental health status at waves 2, 3, 4 and 5. Separate binomial logistic regression models were fitted for MHI and CESD, with good mental health status as the referent category. For each mental health measure, four models were fitted: (1) unadjusted; (2) adjusted for socio-economic variables at waves 1, 2, 3 and 4; (3) adjusted for mental health status at waves 1, 2, 3 and 4; (4) analysis excluding women with poor mental health status at baseline. These four steps were used to assess whether the relationships between previous smoking and subsequent poor mental health were robust after controlling for socio-economical status and mental health history.

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Second, we examined whether mental health status (two categories) at waves 1, 2, 3 and 4 predicted smoking (five categories) at waves 2, 3, 4 and 5. Four multinomial logistic regression models with generalized estimating questions were fitted for each mental health measure separately: (1) unadjusted, (2) adjusted for socio-economic variables at waves 1, 2, 3, and 4; (3) adjusted for smoking status at waves 1, 2, 3 and 4; (4) analysis excluding current smokers at baseline. These four steps were used to assess whether any relationship between previous poor mental health and subsequent smoking was robust after controlling for socio-economic status and smoking history. The generalized estimating equations were fitted using SAS 9.2 (SAS Institute Inc., USA).

Correlation analysis

To explore the association between smoking status and mental health at all waves, Spearman's correlation was used. Smoking status was ordered and MHI and CESD scores were analysed as continuous variables. These analyses were performed using SPSS 18 (SPSS Inc., USA).

Structural equation model

Longitudinal cross-lagged effects models were fitted to test for reciprocal causation effects between smoking and the mental health variables using Amos 17.0. To allow for comparison of regression weights, MHI and CESD scores were standardized. Smoking status was coded as an ordinal variable. Smoking status and mental health status at each wave were entered as individual factors in the model. Paths entered included: (1) smoking at each previous wave to smoking at the next wave; (2) mental health at each previous wave to mental health at the next wave; (3) smoking at each previous wave to mental health at the next wave; (4) mental health at each previous wave to smoking at the next wave; (5) smoking with mental health at wave 1. Bayesian estimations using the Markov Chain Monte Carlo method was used to fit the model as this method allows categorical variables to be included in structural equation models.

Results

Participant characteristics

At wave 1, 57.3% of young women had never smoked, 13.9% were ex-smokers, 9.4% smoked <10 CPD, 6.4% smoked 10–19 CPD and 4.1% smoked $\geqslant 20$ CPD. At later surveys, there was an increase in ex-smokers (20.2% by wave 5) and a decrease in smokers (8.6%, 4.0% and 1.4% smoked <10, 10–19 and $\geqslant 20$ CPD, respectively at wave 5). The prevalence of poor mental health at baseline was 20.4% according to the MHI, which was lower than that measured by the CESD (19.4% and 28.0% according to MHI and CESD, respectively at wave 2). For both measures, the prevalence of poor mental health decreased over time (16.2% and 23.0% according to the MHI and CESD, respectively at wave 5).

Cross-sectional associations

There was a strong dose–response association between smoking and poor mental health (see Table 1). Among smokers, the more CPD smoked, the higher the rate of poor mental health. This relationship was consistent across all waves for both MHI and CESD.

Longitudinal associations

There were statistically significant relationships between smoking and mental health in both directions in the longitudinal analysis (see Tables 2 and 3). First, there was a strong dose–response relationship between smoking and poor mental health, with heavier smokers more likely to have poor mental health in subsequent surveys than never smokers (see Table 2). Exclusion of women with poor mental health at baseline and adjustment for sociodemographic variables and previous mental health status did not alter the relationship.

There was also a dose–response relationship between smoking and poorer mental health, in that women with poor mental health were more likely to be current smokers and to smoke more CPD than women with good mental health (see Table 3). These trends were similar when sociodemographic variables and smoking at previous waves were taken into account or when women who smoked at baseline were excluded.

Spearman's correlations

The correlations shown in Table 4 illustrate the strength of the relationship between smoking and mental health at each previous or subsequent wave. The strongest correlations were between smoking status at different waves (0.71 to 0.90, $p<0.001$), followed by the correlations between mental health at different waves (0.35 to 0.53 between MHI, 0.44 to 0.54 between CESD, $p<0.001$). We observed weaker correlations between mental health and smoking at the same wave (-0.07 to -0.11 for MHI, 0.07 to 0.13 for CESD, $p<0.01$), previous mental health and subsequent smoking (-0.09 to -0.11 for MHI, 0.08 to 0.13 for CESD, $p<0.01$) and previous smoking and subsequent mental health (-0.05 to -0.10 for MHI, 0.05 to 0.10 for CESD, $p<0.01$), although these were all significantly different from zero.

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Table 1. *Cross-sectional prevalence of poor mental health by smoking status at each wave*

	Poor mental health status			
	MHI ⩽52		CESD ⩾10	
Smoking status	%	95% CI	%	95% CI
Wave 1 (1996, $n=10\,026$)				
Never	17.6	(16.7–18.6)**	N.A.	
Ex-smoker	21.5	(19.4–23.5)	N.A.	
Smoke <10 CPD	23.2	(20.6–25.8)	N.A.	
Smoke 10–19 CPD	28.2	(24.8–31.5)	N.A.	
Smoke ⩾20 CPD	33.6	(29.3–38.0)	N.A.	
Wave 2 (1999, $n=5740$)				
Never	17.6	(16.5–18.7)**	24.8	(23.4–26.1)**
Ex-smoker	20.8	(17.9–23.7)	30.8	(27.5–34.2)
Smoke <10 CPD	22.0	(19.4–24.6)	33.5	(30.4–36.6)
Smoke 10–19 CPD	24.0	(20.0–28.0)	37.0	(32.3–41.6)
Smoke ⩾20 CPD	37.6	(30.9–44.4)	50.0	(42.9–57.1)
Wave 3 (2003, $n=4175$)				
Never	15.1	(13.9–16.4)**	21.0	(19.6–22.4)**
Ex-smoker	18.3	(15.4–21.3)	22.2	(19.0–25.4)
Smoke <10 CPD	21.9	(18.6–25.2)	26.9	(23.3–30.4)
Smoke 10–19 CPD	22.0	(16.9–27.0)	31.3	(25.5–37.0)
Smoke ⩾20 CPD	28.0	(20.4–35.6)	37.6	(29.4–45.8)
Wave 4 (2006, $n=3019$)				
Never	13.5	(12.1–14.9)**	20.7	(19.0–22.4)**
Ex-smoker	15.7	(12.7–18.6)	24.4	(20.9–27.9)
Smoke <10 CPD	17.4	(13.5–21.2)	24.4	(20.0–28.8)
Smoke 10–19 CPD	19.9	(13.8–26.0)	28.5	(21.6–35.4)
Smoke ⩾20 CPD	28.1	(16.6–39.5)	47.4	(34.6–60.1)
Wave 5 (2009, $n=1907$)				
Never	15.3	(13.4–17.1)*	22.2	(20.0–24.4)*
Ex-smoker	15.2	(11.8–18.5)	22.1	(18.2–26.0)
Smoke <10 CPD	22.8	(16.8–28.7)	27.8	(21.4–34.2)
Smoke 10–19 CPD	19.3	(11.1–27.6)	22.7	(14.0–31.5)
Smoke ⩾20 CPD	30.0	(13.6–46.4)	43.3	(25.6–61.1)
GEE for all waves (OR, 95% CI)				
Never	1.00		1.00	
Ex-smoker	1.41	(1.17–1.70)**	1.53	(1.20–1.94)**
Smoke <10 CPD	1.59	(1.33–1.89)**	1.69	(1.34–2.12)**
Smoke 10–19 CPD	1.80	(1.51–2.14)**	1.87	(1.49–2.36)**
Smoke ⩾20 CPD	2.17	(1.85–2.55)**	2.27	(1.82–2.81)**

MHI, Mental Health Index, lower scores indicated worse mental health; CES-D, Center for Epidemiologic Studies Depression Scale (not measured at wave 1), higher scores indicated worse mental health; CI, confidence intervals; CPD, cigarettes per day; GEE, generalized estimating equation; OR, odds ratio.

χ^2 test for dose-response trend adjusting for education, marital status, and employment status at each wave: *$p<0.05$, **$p<0.001$.

Structural equation model

Fig. 2 shows the results of the longitudinal reciprocal analysis of the relationship between MHI and smoking. Standard errors were <0.01 for all regression weights. The strongest association was observed between smoking status at each wave ($b=0.85$ to 0.99, $p<0.01$), followed by the association between MHI at each wave ($b=0.45$ to 0.55, $p<0.001$). All the cross-lagged associations were statistically significant and

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Table 2. *Longitudinal analysis of smoking status predicting subsequent mental health status using generalised estimated equation models*

Smoking status (predictor) at waves 1, 2, 3, 4 (never as reference)	Poor mental health (outcome) at waves 2, 3, 4, 5 (good as reference)			
	MHI $\leqslant$52		CESD $\geqslant$10	
	OR	95% CI	OR	95% CI
Model 1: unadjusted				
Never	10.00		1.00	
Ex-smoker	10.21	1.06–1.39	1.25	1.11–1.41
Smoke <10 CPD	10.23	1.07–1.41	1.21	1.07–1.37
Smoke 10–19 CPD	10.29	1.05–1.58	1.35	1.12–1.61
Smoke >20 CPD	10.62	1.24–2.11	1.59	1.26–2.00
Model 2: Adjusted for covariates				
Never	10.00		1.00	
Ex-smoker	10.26	0.94–1.70	1.20	0.91–1.60
Smoke <10 CPD	10.28	0.98–1.68	1.33	1.04–1.71
Smoke 10–19 CPD	1.29	0.99–1.69	1.26	0.99–1.61
Smoke >20 CPD	1.55	1.20–1.99	1.58	1.25–1.99
Model 3: Adjusted for mental health status at waves 1, 2, 3, 4				
Never	1.00		1.00	
Ex-smoker	1.21	1.06–1.38	1.10	0.94–1.29
Smoke <10 CPD	1.16	1.01–1.33	1.06	0.89–1.26
Smoke 10–19 CPD	1.20	0.99–1.47	1.05	0.82–1.35
Smoke >20 CPD	1.45	1.12–1.88	1.16	0.85–1.59
Model 4: Including only participants with good mental health status at baseline wave				
Never	1.00		1.00	
Ex-smoker	1.23	1.04–1.47	1.31	1.14–1.52
Smoke <10 CPD	1.15	0.96–1.38	1.22	1.05–1.42
Smoke 10–19 CPD	1.24	0.95–1.61	1.33	1.06–1.67
Smoke >20 CPD	1.67	1.17–2.39	1.54	1.14–2.08

MHI, Mental Health Index; CES-D, Center for Epidemiologic Studies Depression Scale; OR, odds ratio; CI, confidence intervals; CPD, cigarettes per day.

Covariates included marital status, education level and employment status.

small, suggesting that previous smoking predicted poorer mental health ($b = -0.01$ to -0.02, $p < 0.001$) and previous poorer mental health predicted later smoking ($b = -0.04$ to -0.05, $p < 0.001$). Similar results were found in the reciprocal relationship between smoking and CESD ($b > 0.85$ between smoking, 0.49 to 0.56 between CESD, 0.01 to 0.03 between previous CESD and later smoking and 0.03 to 0.06 between previous smoking and later CESD, $p < 0.001$).

Discussion

There was a strong association between smoking and poor mental health over 13 years of observation for both measures of mental health. Our results support the hypothesis that the relationship between smoking and poor mental health is bi-directional and are consistent with longitudinal studies in the United States that have shown a higher incidence of depression among smokers and a greater risk of becoming a smoker in those with experience of depression at baseline (Breslau *et al*. 1998; Windle & Windle, 2001).

The current study contributes to existing literature on the relationship between smoking and mental health. Our results were consistent with Pasco *et al*.'s (2008) results in showing that smokers were at higher risks of developing depression. Our study followed young women in the period after adolescence when most smoking initiation may have already occurred and we found a bi-directional relationship between smoking and poor mental health. Together with Boden *et al*.'s finding (2010), our results suggest that depressive symptoms are more likely to be related to smoking persistence than initiation. However, in the subset of women who had never smoked at baseline, women with poorer mental health had higher odds of

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Table 3. *Longitudinal analysis of mental health status predicting subsequent smoking status using generalised estimated equation models*

Mental health status (predictor) at waves 1, 2, 3, 4 (good as reference)	Smoking status (outcome) at waves 2, 3, 4, 5 (never smoker as reference)							
	Ex-smoker		Smoke <10 CPD		Smoke 10–19 CPD		Smoke >20 CPD	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
MHI status (⩽52) predicting smoking								
Model 1: Unadjusted	1.12	1.04–1.20	1.22	1.13–1.32	1.34	1.22–1.48	1.91	1.62–2.24
Model 2: Adjusted for covariates	1.11	1.04–1.20	1.22	1.12–1.32	1.31	1.19–1.45	1.87	1.58–2.22
Model 3: Adjusted for smoking at waves 1, 2, 3, 4	1.00	0.81–1.22	1.14	0.90–1.44	1.19	0.80–1.77	1.57	0.89–2.77
Model 4: Including only never smokers at wave 1	1.10	0.89–1.36	1.41	1.16–1.72	1.90	1.31–2.75	2.45	1.15–5.22
CESD status (⩾10) predicting smoking								
Model 1: Unadjusted	1.17	1.08–1.28	1.27	1.15–1.42	1.44	1.27–1.64	2.11	1.68–2.65
Model 2: Adjusted for covariates	1.17	1.07–1.28	1.28	1.15–1.42	1.37	1.20–1.57	2.08	1.62–2.67
Model 3: Adjusted for smoking at waves 1, 2, 3, 4	1.31	1.11–1.55	1.32	1.10–1.58	1.86	1.42–2.45	2.52	1.53–4.15
Model 4: Including only never smokers at wave 1	1.34	1.05–1.72	1.30	1.01–1.68	2.03	1.31–3.16	1.30	0.58–2.90

OR, Odds ratio; CI, confidence intervals; MHI, Mental Health Index, lower scores indicated worse mental health; CES-D, Center for Epidemiologic Studies Depression Scale; CPD, cigarettes per day.

Covariates included marital status, education level, and employment status.

Table 4. *Spearman's correlation (r_s) between smoking status*[a] *and mental health status at all waves*

	W2	W3	W4	W5	W1	W2	W3	W4	W5	W2	W3	W4	W5
Correlations between same variables													
	r_s between smoking				r_s between MHI					r_s between CESD			
W1	0.75	0.72	0.71	0.72	–	0.43	0.40	0.39	0.35				
W2	–	0.87	0.86	0.84		–	0.50	0.46	0.43	–	0.50	0.46	0.44
W3		–	0.90	0.88			–	0.52	0.47		–	0.50	0.50
W4			–	0.90				–	0.53			–	0.54
W5				–					–				–
Correlations between smoking and mental health variables													
					r_s between smoking and MHI					r_s between smoking and CESD			
W1 Smoking					−0.11	−0.07	−0.06	−0.07	−0.06	0.09	0.07	0.05	0.07
W2 Smoking					−0.11	−0.10	−0.09	−0.10	−0.06	0.13	0.10	0.09	0.09
W3 Smoking					−0.10	−0.10	−0.10	−0.09	−0.08	0.12	0.10	0.07	0.07
W4 Smoking					−0.11	−0.09	−0.11	−0.10	−0.05	0.11	0.10	0.08	0.06
W5 Smoking					−0.10	−0.09	−0.09	−0.10	−0.07	0.13	0.08	0.08	0.07

W, Wave; MHI, Mental health index, lower scores indicated worse mental health; CESD, Center for Epidemiologic Studies Depression Scale (not measured at wave 1), higher scores indicated worse mental health.

[a] Smoking status was ranked as: 1 = never, 2 = ex-smoker, 3 = <10 cigarettes per day (CPD); 4 = 10–19 CPD, 5 = ⩾20 CPD.

* All correlations were significant at $p < 0.01$.

smoking in later waves. This suggested that symptoms of psychological distress may play a role in smoking initiation in adult women.

Our bi-directional findings suggest that reducing tobacco use in the general population could assist in reducing the disease burden of both mental health and

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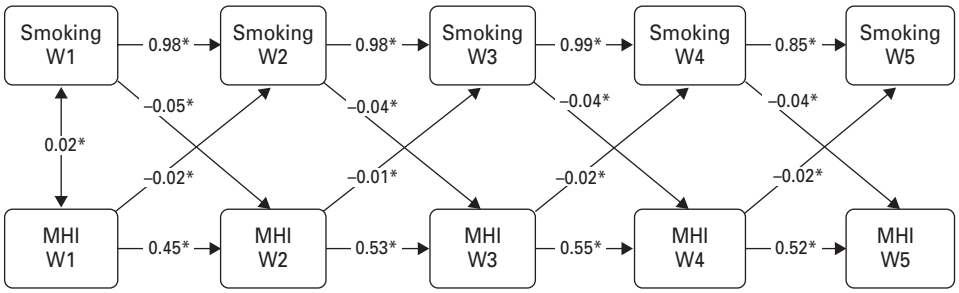

Fig. 2. Regression weights from the structural equation model testing for longitudinal reciprocal effects between smoking and mental health index (lower scores indicated better mental health) at waves 1–5. *$p < 0.001$.

physical disorders caused by smoking. As overall smoking prevalence declines in countries such as Australia (Gartner *et al*. 2009), the relationship between poor mental health and smoking persistence could mean that a greater proportion of continuing smokers have mental health disorders. However, analysis of the 1997 and 2007 Australian National Surveys of Mental Health and Well-being did not find evidence for such relationship (Mathews *et al*. 2010).

The current findings of the strong cross-sectional associations between smoking and poor mental health suggest that there is a significant proportion of smokers with poor mental health in the community. In a recent large prospective study on mid-aged and older women, higher levels of depressive symptoms were associated with lower odds of quitting smoking at follow-up (Holahan *et al*. 2011). Characteristics related to smoking and quitting behaviour may be different among psychological distressed and non-psychologically distressed smokers. For example, compared with smokers who were not depressed, depressed smokers were more likely to believe that quitting smoking would reduce their risk of lung cancer (Floyd *et al*. 2009). Future research on the difference between smokers with poor and good mental health could help to better target population health interventions on smoking cessation to smokers suffering from psychological distress.

There is a common belief among mental health professionals that quitting smoking should not be attempted in people with poor mental health because nicotine withdrawal symptoms that include restlessness, irritability and psychological distress may worsen their mental health (Jarvis, 2004). However, continuing smoking will only provide short-term relief to these symptoms while quitting may reduce psychological distress in the long term (Ragg & Ahmed, 2008). Recent research shows that quitting smoking does not increase depression and anxiety (Torres *et al*. 2010; Bolam *et al*. 2011) and that the relationship between smoking and psychological distress weakens with time since quitting (Leung *et al*. 2010). Our findings that ex-smokers had lower odds of poor mental health at later surveys compared with current smokers also contradict the belief that quitting can lead to poorer mental health. Health professionals need to be trained to assist smokers with poor mental health to quit because it may improve their mental health, physical health and quality of life.

Limitations

As our study only examined young adult women, our findings may not apply to young men and older adults. Some variables of interest, such as nicotine dependence, were not available in the ALSWH data. Previous studies have shown that nicotine dependence may be an important factor in the relationship between mental health, physical health and quitting outcomes (Breslau & Johnson, 2000; Boden *et al*. 2010). We were also not able to examine the relationship between smoking and anxiety alone because the MHI is a measure of psychological distress related to both conditions. Although co-morbidity is common, which makes separating the two difficult in research, it may be necessary to consider these conditions separately as risk factors because interventions may differ between them. Future research that can distinguish the relationships between anxiety and depression and smoking will clarify the issue. Finally, as with all other longitudinal studies, the survey response and attrition rates are limitations. People with mental health disorders are less likely to participate and more likely to drop out of longitudinal studies, as are smokers. Also, subpopulations that have a high prevalence of both mental health disorders and smoking, such as the homeless and institutionalized people, were not included in the original sample. Therefore, our results are likely to underestimate the relationship between smoking and poor mental health.

Conclusions

Smoking prevalence remained disproportionally high amongst psychologically distressed young women

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over the 13-year study period. Longitudinal analyses revealed that tobacco smoking predicted poor mental health and poor mental health predicted continuing smoking and smoking more cigarettes, suggesting a bi-directional relationship. Strategies to reduce tobacco use among young women may improve this population's mental health and their ability to quit and reduce the mortality and morbidity caused by tobacco smoking and depression and anxiety. Public health communication and training is required to enable health professionals to deliver effective quitting programmes to smokers with depression and anxiety. Population smoking reduction strategies are also needed to reduce the burden of disease from both tobacco smoking and poor mental health in the community.

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Declaration of Interest

None.

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