

# Smoking uptake is associated with increased psychological distress: results of a national longitudinal study

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## ABSTRACT

**Background** There is evidence that smoking is associated with poorer mental health. However, the underlying mechanisms for this remain unclear. We used longitudinal data to assess whether smoking uptake, or failed quit attempts, are associated with increased psychological distress.

**Methods** Data were used from Waves 3 (2004/05), 5 (2006/07) and 7 (2008/09) of the longitudinal New Zealand Survey of Family, Income and Employment. Fixed-effects linear regression analyses were performed to model the impact of changes in smoking status and quit status (exposure variables) on changes in psychological distress (Kessler 10 (K10)).

**Results** After adjusting for time-varying demographic and socioeconomic covariates, smoking uptake was associated with an increase in psychological distress (K10: 0.22, 95% CI 0.01 to 0.43). The associations around quitting and distress were in the expected directions, but were not statistically significant. That is, smokers who successfully quit between waves had no meaningful change in psychological distress (K10:  $-0.05$ , 95% CI  $-0.34$  to  $0.23$ ), whereas those who tried but failed to quit, experienced an increase in psychological distress (K10: 0.18, 95% CI  $-0.05$  to  $0.40$ ).

**Conclusions** The findings provide some support for a modest association between smoking uptake and a subsequent increase in psychological distress, but more research is needed before such information is considered for inclusion in public health messages.

## INTRODUCTION

There is growing evidence that current smokers are more likely than non-smokers to report poorer mental health (eg, depression, depressive symptoms, mental illness, mental disorders and psychological distress).<sup>1–5</sup> Similarly, people with poorer mental health are more likely to smoke.<sup>6–10</sup> Existing longitudinal studies on smoking and mental health suggest that it is smoking that contributes to adverse mental health outcomes rather than vice versa.<sup>11–15</sup>

In the four studies that investigated the causal association between smoking and depression, strong evidence was found for the causal pathway from smoking to depression or depressive symptoms (using dichotomous disease classification), with limited evidence for depression being an antecedent of subsequent smoking.<sup>12–15</sup> However, it is important to examine the impact of smoking uptake on changes in mental health using a continuous measure of mental health (or distress), rather than dichotomous disease classification, to identify small (but important) changes on the spectrum of mental

health over time. Therefore, building on previous research findings,<sup>12–15</sup> we proposed the following research question: ‘What is the effect of smoking uptake on psychological distress?’, hypothesising that moving from non-smoking into smoking will lead to an increase in psychological distress (a continuous measure of mental health).

The possible mechanisms that may underlie the pathway from smoking to changes in mental health are still unclear. Nicotine changes neurotransmitter activity in the brain and this may be the mechanism for an increased risk of depression,<sup>12 16 17</sup> but psychological mechanisms may also be relevant. For example, it is only recently that the role of quit attempts within the relationship between smoking and poorer mental health has been considered.<sup>1 3 18</sup> Cross-sectional studies which have considered the role of quit attempts have found high levels of psychological distress among smokers compared with non-smokers and current smokers who tried to quit smoking but failed, compared with ex-smokers or never-smokers.<sup>1 3 18</sup> In a cross-sectional analysis, we found that current smokers who tried to quit smoking in the last 12 months were over 70% more likely to report high to very high levels of psychological distress than long-term ex-smokers.<sup>18</sup> In addition, it has been suggested that levels of psychological distress decrease as time since quitting increases, suggesting a mental health benefit of successful quitting.<sup>3</sup> Another possible explanation for the association between smoking and mental health may therefore be the increased distress in current smokers who try but fail to quit smoking. Such an increase in distress after a relapse may be explained by psychological mechanisms like feelings of guilt and shame, low self-efficacy and lost self-control.<sup>11 19–21</sup> Therefore, failed quit attempts may partly explain the apparent relationship between current smoking and poorer mental health. Yet, a recent longitudinal study reported no evidence of an association between quitting smoking and depression or anxiety questions, in a small prospective multinational cohort of smokers.<sup>22</sup> Nevertheless, the group of actual successful quitters who were still abstinent after 6 months was, however, small, limiting the statistical power of the analysis, making it impossible to explore if there were any differences between the mental health outcomes of successful quitters and non-quitters. Therefore, we examined this issue further with a second research question: ‘What is the effect of quit attempts on changes in psychological distress?’. We

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hypothesised that current smokers who tried to quit but failed would show an increase in psychological distress, whereas those who successfully quit would show a decrease in psychological distress.

### METHODS

#### Study design

This study used longitudinal data from Waves 3 (2004/05), 5 (2006/07) and 7 (2008/09) from the Survey of Family, Income and Employment (SoFIE; Wave 1–7 data release, V2), which was conducted from 2002 to 2010 in New Zealand.<sup>23</sup> In short, SoFIE is a nationally representative longitudinal survey of the usually resident population living in private households in New Zealand. During annual face-to-face interviews, information was obtained on individual and family factors, such as labour market activity, education, marital status and household income. In Waves 3, 5 and 7 of SoFIE, a detailed health module was included with questions on health-related quality of life, psychological distress, chronic disease and health behaviours, including smoking and alcohol use. The initial SoFIE baseline sample comprised approximately 11 500 responding private households (response rate of 77%) with over 22 000 adults responding in Wave 1 which reduced to just over 19 000 adults in Wave 3, about 18 000 adults in Wave 5 and over 16 000 adults in Wave 7. A total of 17 140 respondents were included in the longitudinal analyses (response rate=77% of Wave 1 respondents). Attrition was higher in Māori or 'Other ethnicity' respondents, as well as those with low income or with poorer health status, were more likely to drop out over the seven waves of the study.

#### Exposure measures

##### Smoking status

Responses to two questions about cigarette smoking were used to determine the respondents' smoking status at each wave: never-smoker, ex-smoker or current smoker. A person was classified as never-smoker if he or she had never smoked one or more cigarettes a day on a regular basis; as ex-smoker if he or she reported not regularly smoking (at the time of the interview) but having 'ever been a regular smoker of one or more cigarettes a day'; and finally as current smoker if he/she reported to 'regularly smoke one or more tobacco cigarettes per day'. Based on this information, a two-level smoking status variable was created: (i) non-smokers (never-smokers and ex-smokers grouped together) and (ii) current smokers. Non-smokers were used as the reference group, so the fixed-effects regression modelled smoking uptake between waves.

##### Quit status

The quit status of current smokers and ex-smokers was derived by asking current smokers: 'In the last 12 months, have you tried to stop smoking altogether?'. Consequently, a three-level quit status variable was created: (i) current smoker who had not tried to quit smoking, (ii) current smoker who had tried to quit smoking but failed and (iii) successful quitter (ie, ex-smokers who had quit in the last 2 years). Current smokers who had not tried to quit were used as the reference group, so the fixed-effects regression modelled quit attempts (successful or unsuccessful) between waves compared with current smokers who did not try to quit.

##### Outcome measure

The main outcome of interest was changes in the level of non-specific psychological distress. This was measured by the Kessler Psychological Distress Scale (K10),<sup>24–26</sup> which is a 10-item

questionnaire with questions regarding negative emotional states (eg, feeling nervous, hopeless or worthless) in the 4 weeks preceding the survey. An example of a K10 question is: 'During the past 4 weeks, about how often did you feel downhearted and depressed?', with answers on a Likert scale from 'none of the time' to 'all of the time'. The K10 scores range from 10 to 50 and were grouped into four levels for descriptive purposes: low (10–15), moderate (16–21), high (22–29) and very high (30+).<sup>24 27</sup> Psychological distress was treated as continuous in the regression analyses.

#### Other variables

In the fixed-effect regression analyses, we controlled for the following time-varying variables: social marital status (partnered (reference group) vs not partnered), labour force status (employed (reference group) vs not employed), and NZiDep which is a measure of individual deprivation for New Zealand using eight questions including 'In the past 12 months have you been forced to buy cheaper food so that they could pay for other necessities or have you received help in the form of clothes or money from a community organisation?' (this was coded as: no deprivation factors (least deprived, reference group) vs one or two deprivation factors, and three or more deprivations factors (most deprived)).<sup>28</sup>

#### Statistical analysis

All analyses were conducted using individual unit data from Waves 3, 5 and 7 of SoFIE in SAS 8.2 (in the Statistics NZ data laboratory in Wellington). All numbers of participants presented in this paper are rounded to the nearest multiple of five, with a minimum value of five, as per Statistics New Zealand confidentiality protocol. Tabular analyses are conducted on a non-balanced panel (n=17 140) adult original sample members who responded in Waves 3, 5 and/or 7 (about 15 100 responded in all three waves, with an additional 2040 in either Waves 3 and 5 or Waves 5 and 7). The first longitudinal analysis, of smoking status, included all people with non-missing psychological distress and smoking data (n=17 140; approximately 47 000 observations across the three waves). The second analysis, of quitting smoking, included respondents who were current or ex-smokers at Wave 3 (n=7950; approximately 22 000 observations).

To explore changes in smoking and quit status over time, transition tables of smoking status and quit status summing transitions from Wave 3 to Wave 5, with transitions from Wave 5 to Wave 7 were used. Fixed-effects linear regression models were used to investigate the longitudinal association between: (i) two-level smoking status (exposure) and psychological distress (outcome) and (ii) three-level quit status (exposure) and psychological distress (outcome). The fixed-effects linear regression explores the effect of a change in smoking status (from non-smoking to smoking), or a change in quit status (from current smoker who did not try to quit into current smoker who tried to quit but failed (failed quit attempt) or ex-smoker (successful quit attempt)) on change in psychological distress score between Waves 3, 5 and 7. Model 1 presents the crude model. The fully adjusted model adjusted for time-varying social marital status (partnered, not partnered) and socio-economic variables (labour force status and NZiDep).

### RESULTS

Of the 17 140 respondents included in the longitudinal analyses at Wave 3, 52% were never-smokers, 28% ex-smokers (successful quitters), 7% current smokers who had tried to quit in the past year, and 11% current smokers who had not tried to

quit (table 1). Cross-sectionally (at Wave 3), the mean K10 score was 13.4 with a SD of 4.6. High and very high levels of psychological distress were more common in current smokers (11%; mean=14.6, SD=5.7) than in ex-smokers

(5%; mean=13.3, SD=4.5) or never-smokers (5%; mean=13.0, SD=4.1). There were much higher levels of psychological distress in current smokers who tried to quit smoking (15%), compared with current smokers who did not try to quit (9%).

**Table 1** Demographic and socioeconomic variables at Wave 3 by Kessler 10 Group (levels of psychological distress)

	Total n	Kessler 10 Group (scores)									
		Low (10–15)		Moderate (16–21)		High (22–29)		Very High (30+)		Missing	
	n	n	%	n	%	n	%	n	%	n	%
Total	17140	12950	75.6	2415	14.1	800	4.7	250	1.5	730	4.3
Smoking status											
Current smoker	3215	2235	69.5	600	18.7	260	8.1	95	3.0	25	0.8
Ex-smoker	4730	3675	77.6	670	14.1	200	4.2	60	1.3	125	2.6
Never-smoker	8875	7035	79.3	1145	12.9	335	3.8	90	1.0	270	3.0
Missing	310	5	1.6		0.0		0.0	5	1.6	300	96.8
Quit status											
Successful quitter	4735	3675	77.6	670	14.1	200	4.2	60	1.3	125	2.6
Current (tried to quit)	1245	780	62.7	270	21.7	130	10.4	55	4.4	10	0.8
Current (didn't try to quit)	1970	1455	73.9	325	16.5	130	6.6	45	2.3	15	0.8
Missing/never-smoker	9190	7035	76.6	1145	12.5	335	3.6	90	1.0	580	6.3
Sex											
Male	7855	6105	77.7	1010	12.9	315	4.0	70	0.9	355	0.0
Female	9285	6845	73.7	1405	15.1	485	5.2	180	1.9	375	3.8
Age group (years)											
15–24	2585	1770	68.5	460	17.8	160	6.2	35	1.4	155	6.0
25–34	2360	1720	72.9	395	16.7	110	4.7	40	1.7	100	4.2
35–44	3485	2595	74.5	505	14.5	175	5.0	60	1.7	155	4.4
45–54	3295	2595	78.8	390	11.8	140	4.2	50	1.5	120	3.6
55–64	2620	2080	79.4	300	11.5	95	3.6	45	1.7	100	3.8
65+	2790	2190	78.5	365	13.1	115	4.1	20	0.7	100	3.6
Ethnicity											
NZ European	13215	10280	77.8	1775	13.4	535	4.0	170	1.3	455	3.4
Māori	1970	1350	68.5	305	15.5	130	6.6	50	2.5	130	6.6
Pacific	720	440	61.1	140	19.4	60	8.3	5	0.7	70	9.7
Asian	865	610	70.5	145	16.8	45	5.2	15	1.7	55	6.4
Other	375	275	73.3	50	13.3	25	6.7	10	2.7	15	4.0
Education											
Degree or higher	2445	1980	81.0	300	12.3	60	2.5	10	0.4	95	3.9
Postschool qualification	5865	4510	76.9	835	14.2	225	3.8	95	1.6	200	3.4
School qualification	4580	3435	75.0	675	14.7	225	4.9	50	1.1	195	4.3
No qualification	4225	3030	71.7	600	14.2	280	6.6	90	2.1	220	5.2
Labour force status											
Employed	11320	8925	78.8	1460	12.9	385	3.4	115	1.0	435	3.8
Not employed, active	290	180	62.1	55	19.0	40	13.8	5	1.7	15	5.2
Not employed, inactive	5485	3840	70.0	900	16.4	375	6.8	125	2.3	245	4.5
Standard family type											
Couple only	4875	3965	81.3	590	12.1	190	3.9	35	0.7	95	1.9
Couple with children	7035	5500	78.2	975	13.9	285	4.1	80	1.1	190	2.7
Sole parent	1555	1045	67.2	290	18.6	135	8.7	50	3.2	35	2.3
Not in a family nucleus	3320	2435	73.3	560	16.9	190	5.7	80	2.4	55	1.7
Social marital status											
Partnered	10960	8635	78.8	1395	12.7	425	3.9	105	1.0	400	3.6
Not partnered	6155	4315	70.1	1020	16.6	375	6.1	145	2.4	305	5.0
Self-rated health											
Excellent	5590	4950	88.6	490	8.8	100	1.8	10	0.2	35	0.6
Very good	5790	4655	80.4	820	14.2	205	3.5	55	0.9	50	0.9
Good	3685	2625	71.2	710	19.3	240	6.5	70	1.9	45	1.2
Fair/poor	1520	725	47.7	395	26.0	250	16.4	110	7.2	40	2.6
Missing	555									555	100.0
NZIDep											
0 deprivation factors	12070	10150	84.1	1425	11.8	335	2.8	75	0.6	85	0.7
1–2 deprivation factors	3390	2285	67.4	720	21.2	275	8.1	75	2.2	35	1.0
3+ deprivation factors	1070	505	47.2	270	25.2	190	17.8	95	8.9	10	0.9
Missing	610	5	0.8			5	0.8			600	98.4

NZIDep, individual deprivation.

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**Table 2** Transition probability matrices for A: smoking status (n=17 140) and B: quit status (n=7950—current and ex-smokers at Wave 3)

A Wave t	Wave t+2				B Wave t	Wave t+2			
	Current smoker	Ex-smoker	Never-smoker	Total (n)		Ex-smoker	Current tried to quit	Current (no quit)	Total (n)
Current smoker	0.76	0.13	0.02*	6370	Ex-smoker	0.90	0.02	0.02	9520
Ex-smoker	0.05	0.89	0.01*	9655	Current tried to quit	0.16	0.42	0.30	2295
Never-smoker	0.01	0.01	0.92	17645	Current (no quit)	0.11	0.19	0.61	3825
Total (n)	5725	9675	16550	34280	Total (n)	9405	1955	3290	15915

Transitions into or out of refused, don't know or missing responses are not included in the table, but are included in probability denominators. Italicised probabilities present no change (stability) between waves.

\*Nonsense transitions (current to never, ex-smokers to never-smokers), less than 1% of all observations.

Furthermore, females, sole parents, not-partnered respondents, respondents who were not employed but actively looking for work, most deprived individuals, and respondents who rated their own health as poor were more likely to report high to very high levels of psychological distress (table 1).

Turning to the time-varying results over the study period, 660 respondents started smoking and 810 successfully quit smoking. table 2 presents transition matrices of smoking status (A) and quit status (B) over time. There was relative stability in smoking status between waves with 76% of current smokers remaining current smokers in the next wave (2 years later). However, of those current smokers, 13% became ex-smokers (successfully quit) by the next wave. Table 2A also shows that 5% of ex-smokers relapsed and reported being current smokers in the next waves, and 1% of never-smokers start smoking by the next wave. Table 2B presents transitions in the quit status in respondents who were current or ex-smokers in Wave 3. Of those respondents who were current smokers but tried to quit in the past 12 months, 16% had successfully quit (became ex-smokers) by the next wave. Of those respondents who were current smokers but had not tried to quit in the past 12 months, 19% were still current smokers but had tried to quit smoking, and 12% had successfully quit (became ex-smokers). Table 2 also highlights the small number of non-sense transitions (changes from current or ex-smoker to never-smoker, about 1% of all observations) which are common to survey data with large samples.

The pooled regression (fully adjusted) model (not controlling for within-individual correlations) estimated a highly significant and strong effect of smoking on K10 (0.65, 95% CI 0.55 to

0.76). However, this analysis does not control for time-invariant confounding. The fixed-effects linear regression analysis of smoking status and psychological distress suggested that respondents who took up smoking between waves experienced a small (but significant) increase in psychological distress (Model 1: increase in K10 score: 0.25, 95% CI 0.04 to 0.47), which persisted in the fully adjusted model (Model 2: K10: 0.22, 95% CI 0.01 to 0.43) (table 3). The smoking estimate of psychological distress was half that of other significant life events in the fully adjusted model, such as changes in marital status or changes in labour force status.

The pooled regression (fully adjusted) model (not controlling for within-individual correlations) estimated a strong association of quitting smoking on K10 (ex-smoker: -0.33, 95% CI -0.47 to -0.18; current smoker but tried to quit: 0.63, 95% CI 0.42 to 0.84). However, this does not control for time-invariant confounding. The fixed-effects linear regression analysis (Table 4) of quit status and psychological distress (in respondents who were current or ex-smokers at Wave 3, n=7950) indicated that ex-smokers (current smokers who successfully quit between waves) experienced a small (but non-significant) decrease in psychological distress (Model 1: K10: -0.06, 95% CI -0.34 to 0.23), whereas, current smokers who tried but failed to quit smoking experienced an increase in psychological distress

**Table 3** Fixed-effects linear regression model, with change in smoking status as the exposure variable and psychological distress (K10) as the outcome variable (n=17 140)

Variable	Model 1 Crude		Model 2 Fully adjusted	
	$\beta$	95% CI	$\beta$	95% CI
Current smoker	0.25*	0.04 to 0.47	0.22*	0.01 to 0.43
Non-smoker (ref.)	0		0	
Time-varying confounders				
Social marital status not partnered			0.38†	0.21 to 0.56
Social marital status partnered (ref.)			0	
Labour force status not employed			0.44†	0.30 to 0.58
Labour force status employed (ref.)			0	
NZiDep level 1 (most deprived)			1.66†	1.44 to 1.88
NZiDep level 2			0.55†	0.44 to 0.67
NZiDep level 3 (least deprived) (ref.)			0	

Model 1 = Crude model.

Model 2 = Full model: adjusted social marital status, labour force status, and NZiDep (individual deprivation).

\*Significant or marginally significant ( $p \leq 0.05$ ).

†Significant at 0.1% level ( $p < 0.001$ ).

NZiDep, individual deprivation.

**Table 4** Fixed-effects linear regression model, with quit status as exposure variable and psychological distress (K10) as the outcome variable (n=7950—current and ex-smokers at Wave 3)

Variable	Model 1 Crude		Model 2 Fully-adjusted	
	B	95% CI	$\beta$	95% CI
Ex-smoker	-0.06	-0.34 to 0.23	-0.06	-0.34 to 0.23
Current smoker (tried to quit)	0.22*	-0.01 to 0.44	0.18	-0.05 to 0.40
Current smoker (didn't try to quit) (ref.)	0		0	
Time-varying confounders				
Social marital status not partnered			0.43†	0.16 to 0.70
Social marital status partnered (ref.)			0	
Labour force status not employed			0.73†	0.51 to 0.96
Labour force status employed (ref.)			0	
NZiDep level 1 (most deprived)			1.32†	1.00 to 1.63
NZiDep level 2			0.42†	0.24 to 0.60
NZiDep level 3 (least deprived) (ref.)			0	

Model 1 = Crude model.

Model 2 = Full model: adjusted social marital status, labour force status, and NZiDep.

\*Marginally significant ( $p \leq 0.05$ ).

†Significant at 1% level ( $p < 0.01$ ).

‡Significant at 0.1% level ( $p < 0.001$ ).

NZiDep, individual deprivation.



(Model 1: K10: 0.22, 95% CI -0.01 to 0.44). However, this increase in psychological distress reduced by 18% (ie, from 0.22 to 0.18) with the CI including the null after adjusting for the time-varying confounding factors (Model 2: K10: 0.18, 95% CI -0.05 to 0.40). The fully adjusted models suggest that becoming non-partnered, unemployed or experiencing an increase in individual deprivation was associated with increased psychological distress over time (tables 3 and 4).

## DISCUSSION

### Main findings

Based on the growing evidence for a causal pathway from smoking to depression, we hypothesized that smoking uptake would increase psychological distress over time. This hypothesis was supported in the present study, albeit with the increase not being particularly large in terms of K10 scores (though half the size of associated with change in marital status and labour force status). The increase in psychological distress with smoking uptake of 0.22 (95% CI 0.01 to 0.43) equates to about 4%–5% of the population SD in K10 scores, and is small in terms of the ‘clinical’ groupings of K10 scores (low (10–15), moderate (16–21) and high (22–29) levels of psychological distress). We also hypothesized that current smokers who tried to quit smoking but failed between waves, would experience an increase in psychological distress, whereas, those who successfully quit would experience a decrease in distress. This hypothesis was partly supported in the present study, but the impact was not statistically significant in the fully adjusted model. Indeed, the findings in this study suggest the importance of factors such as NZiDep on psychological distress (individuals experiencing an increase in deprivation resulted in an increase in psychological distress).

### Strengths and limitations

The strengths of the present study were the use of longitudinal data, the large sample size, the ability to adjust for time-varying demographic and socioeconomic variables, and the use of psychological distress as a continuous measure of mental health. We also used fixed-effects linear regression modelling which controls for all observed and unobserved time-invariant confounding by modelling changes within individuals over time, and ignoring ‘between-individual’ differences.<sup>29</sup>

It is important to recognise that conclusions concerning the findings in the present study rely on some of the underlying assumptions of the fixed-effects method. The fixed-effects linear regression model is driven by change in the exposure variable.<sup>29</sup> Thus, information on SoFIE respondents who did not change with regard to their smoking or quit status over time, do not provide information on the smoking estimate. It is well known that smoking cessation can be a difficult process with multiple quit attempts often preceding long-term abstinence,<sup>30</sup> and it is therefore especially likely that multiple failed quit attempts will lead to an increase in psychological distress in current smokers. The mean-centred estimate that is produced by the fixed-effects linear regression method may be sensitive to unobserved time-varying confounding (eg, changes in feelings of mastery; other life stressors that cause both smoking uptake and psychological distress), and health selection (eg, the reverse pathway from psychological distress to smoking status or quit status),<sup>31</sup> which, consequently, might have biased the estimates that were found in the present study. However, with respect to the latter, previous research found only a weak (if any) association for the pathway from depression to smoking.<sup>12–15</sup> The structure of the SoFIE questions made it not possible to model the reverse pathway, as

smoking status and quit attempts were measured over the past 12 months, and the K10 questions were measured over the previous 4 weeks. Therefore, the data has a natural time lag between the smoking variables and K10.

The smoking status variable used in this analysis grouped never-smokers and ex-smokers together as non-smokers. Therefore, the effect of increased psychological distress may hide differential effects of smoking uptake, compared with relapse, and future research should aim to separate out these effects. The K10 scale was used as a measure of psychological distress in this study, whereas other longitudinal studies on smoking and mental health tend to use more clinical measures of mental health or disorders (which are also sometimes limited by their dichotomous nature). The K10 was originally developed to screen for serious mental illness in the general population,<sup>24–26</sup> and high levels of K10 are predictive of anxiety and depressive disorders.<sup>24 27</sup> Although, the cross-sectional distribution of the K10 is skewed (towards lower scores; mean K10 score at Wave 3 was 13.4, SD 4.6), the distribution of the change in K10 scores between waves was normal.

Although the original SoFIE study population (Wave 1) was a nationally representative sample of New Zealand households, the health module data was only collected in Waves 3, 5 and 7. It has been found that younger people of lower socioeconomic status are more likely to drop out of SoFIE.<sup>23</sup> This sample attrition may therefore have led to selection bias, and reduced the generalisability of the present study results. However, unless the dropout rates were jointly distributed by smoking status, quit status and psychological distress, the effect of attrition on the exposure–outcome relationship is likely to be minimal.<sup>32</sup> We compared the Wave 3 health information on respondents who dropped out (n=2045) by Wave 7 with those who responded in all three health modules (n=15 100), and found no major differences in the distribution of the smoking and K10 variables in those who missed a wave in the study.

Despite the findings of this study, the evidence base for health authorities being able to state in public health messages that ‘smoking causes stress’ is still insufficient. While health authorities have many other scientifically stronger messages around tobacco-related harm (that can be used in health warnings and mass media campaigns), further research on the topic of smoking and stress remains important. This is because it has implications for addressing public misperceptions around smoking and mental health (eg, beliefs around smoking relieving stress) and also for optimising quitting support. That latter can potentially involve how health workers and others (family and friends) can best support quit attempts, but also how best to mobilise any distress from a failed quit attempt into planning for a new quit attempt.

## CONCLUSIONS

The findings provide some support for a modest association between smoking uptake and a subsequent increase in psychological distress, but more research is needed before such information is considered for inclusion in public health messages.

### What is already known

- There is growing evidence for a causal pathway from smoking to poorer mental health, but there is still much uncertainty about the mechanisms.

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## What this study adds

- ▶ More specific evidence for a small increase in psychological distress after smoking uptake (in a longitudinal study with multiple waves).
- ▶ While there are possible relationships between psychological distress and both successful quitting and failed quit attempts, these were not at a statistically significant level in this relatively large study.

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**Contributors** KNC is the principal investigator of the SoFIE-Health project. She developed the research questions, led the analyses and final drafting of the paper. FSvdD undertook this research towards a Masters of Health & Society, Wageningen University, The Netherlands. She helped develop the research questions, led the literature review and first draft of the paper. NW helped in the interpretation of the analyses and critically revised drafts of the paper. TB helped in developing the analysis plan and interpretation of the analyses for the paper and critically revised drafts of the paper. All authors approved the final version of the paper.

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**Data sharing statement** Data from the longitudinal Survey of Family, Income and Employment is available from Statistics New Zealand [www.stats.govt.nz](http://www.stats.govt.nz).

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