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Depression motivates quit attempts but predicts relapse: Differential findings for gender from the International Tobacco Control Study.

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Abstract

Aims: Determine whether signs of current depression predict attempts to quit smoking, and short-term abstinence among those who try, and to test moderating effects of gender and cessation support (pharmacological and behavioural).

Design: Prospective cohort with approximately annual waves. Among smokers at one wave we assessed outcomes at the next wave using mixed-effects logistic regressions.

Setting: Waves 5 to 8 of the Four Country International Tobacco Control Study: a quasi-experimental cohort study of smokers from Canada, USA, UK and Australia.

Participants: 6811 tobacco smokers who participated in telephone surveys.

Measurements: Three level depression index: 1) neither low positive affect (LPA) nor negative affect (NA) in the last 4 weeks; 2) LPA and/or NA but not diagnosed with depression in the last 12 months; 3) diagnosed with depression. Outcomes were quit attempts and one month abstinence among attempters.

Findings: Depression positively predicted quit attempts, but not after controlling for quitting history and motivational variables. Controlling for all covariates, depression consistently negatively predicted abstinence. Cessation support did not moderate this effect. There was a significant interaction with gender for quit attempts (p=0.018) and abstinence (p=0.049) after controlling for demographics, but not after all covariates. Depression did not predict abstinence among men. Among women, depressive symptoms (OR=0.63, 95% CI = 0.49-0.81) and diagnosis (OR=0.46, 95% CI = 0.34-0.63) negatively predicted abstinence.

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Conclusions: Smokers with depressive symptoms or diagnosis make more quit attempts than their non-depressed counterparts, which may be explained by higher motivation to quit, but they are also more likely to relapse in the first month. These findings are stronger in women than men.

Key words: Depression, smoking cessation, relapse, depressive symptoms, gender, cessation support

Tobacco smoking is a leading cause of preventable mortality and morbidity. Smoking prevalence among those with clinical depression is approximately twice as high as the general population [1-3]. However, there have been mixed findings as to whether depression is associated with lower rates of successful smoking cessation. Some studies have found that depression predicts earlier relapse [4-10]. In a 2003 meta-analysis, Hitsman et al. [11] concluded that there was no association; however, a 2013 update found that a history of major depression was associated with relapse on short-term (three months) and long-term (at least six months) quit attempts [12].

Mechanisms linking depression and difficulty quitting remain unclear. The relationship is possibly bidirectional, with smoking contributing to depression and vice versa, as well as common factors underlying both. Pharmacological theories postulate a mediating role of neurochemicals, namely dopamine [13] and acetylcholine [14], on affective symptoms, with depressed smokers finding these neurochemical processes particularly reinforcing. Thus, depression-prone smokers may relapse because they experience a loss in pleasure that was previously buttressed by nicotine [15]. It remains unclear whether tobacco has a positive effect on mood, whether it only controls chronic fluctuations in nicotine withdrawal [16], or some combination of both.

Despite possible short-term declines in mood after quitting, there is growing evidence that quitting smoking leads to long-term improvements in psychological wellbeing [17]. This tends to favour the hypothesis that any actual benefits of smoking on mood are short-lived and due to prevention of withdrawal related

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negative affect. However, it is also possible that an improvement in mental health precipitates successful smoking cessation. Smokers with depression report more severe and longer withdrawals than non-depressed smokers [18,19], explaining why depressed smokers are more relapse prone. In addition, patients in mental health settings may get less help to quit smoking because of concerns around the impact on mental health [20], which could contribute to poorer outcomes.

An alternative affective/cognitive model explains the association with difficulty quitting smoking as due to low self-efficacy [21], lack of adaptive coping strategies, negative cognitive style [22], and emotion regulation deficits [23,24]. In one study depression mediated the relationship between problem-focused coping and social support seeking on cessation failure [4].

The current study uses data from a population-based sample of smokers from the International Tobacco Control Four Country (ITC-4) survey to examine the role of depression symptoms on subsequent quitting behaviours, providing a rare opportunity to explore the relationship between depression and quitting in a population-based sample. There is growing evidence that cognitive motivational factors are more predictive of trying than abstaining [25,26,6], so we separately examine quit attempts and short-term abstinence. We predicted that smokers with depression symptoms or a diagnosis will be less likely to achieve one month abstinence compared to their non-depressed counterparts, and aim to clarify whether this is due to reduced rates of trying and/or a greater propensity to early relapse (within one month). We chose one month because key predictors of relapse are most strongly predictive in this period [27,28].

Other factors may moderate the effects of depression on quitting. Pharmacological and behavioural support (e.g., quit lines) may mitigate some of the negative effects of depression on capacity to successfully quit. Women are more likely to report that they smoke to reduce negative affect [29], exhibit stronger relationships between depressive disorders and smoking [30], and women with depression have poorer smoking cessation outcomes when compared to men [9].

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Study aims are to: (1) Determine whether smokers who report more signs of depression are more or less likely to report making quit attempts when followed up 12 months later; (2) Among those who made a quit attempt, determine whether they are less likely to report achieving one month abstinence; and (3) Determine whether gender and the use of support (pharmacological or behavioural) moderates the association between signs of depression and the two quitting outcomes.

Method

Participants

Data came from waves 5 to 8 (2006/2007 – 2010/2011) of the International Tobacco Control Four Country (ITC-4) project. The ITC-4 is a quasi-experimental, approximately annual cohort survey of smokers in Canada, UK, USA, and Australia with stratified single stage random sampling. Within each country, the population was stratified into large geographical regions (e.g. state) to ensure representation was proportional to regional population size. Surveying was conducted via computer-assisted telephone interview. A detailed description of the ITC study conceptual framework [31] and methodology [32] can be found elsewhere. The study protocol was approved by institutional review boards or research ethics boards in each of the four countries. Participants were eligible for the current study if they provided valid data on all variables for one or more baseline (T1) waves (5: 2006/7; 6: 2007/8; and 7: 2008/9) and the corresponding follow-up (T2) wave (6, 7, and 8: 2010/11), and were daily smokers at the relevant T1 wave. Participants could have one to three T1-T2 pairs. Predictors were not collected when quit at a wave, so the wave pair starting with those waves were excluded. See supplementary Figure 1 for sample breakdown. Attrition rates were 29.0% between waves 5 to 6, 26.2% waves 6 and 7, and 29.2% waves 7 and 8. There were 5% to 7% greater attritions for those reporting depressive symptoms, a significant difference for each wave pair.

Measures

Main exposure variable:

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Depression index: From wave 5 of the ITC-4, participants were asked two items from the Primary Care Evaluation of Mental Disorders Procedure questionnaire [33] assessing core symptoms of a depressive episode (DSM-IV), and have excellent sensitivity (96%) and moderate specificity (57%) [34]. Low positive affect was assessed by, “During the last month, have you often been bothered by little interest or pleasure in doing things?” and Depressed mood by, “During the last month, have you often been bothered by feeling down, depressed, or hopeless?” Those answering “Yes” to either question were also asked, “In the last year, have you been told by a doctor or other health care provider that you have depression?” This resulted in a three level depression index; 1) Not bothered by either symptom, 2) Bothered by either symptom but no diagnosis in the previous year, and 3) Bothered by either symptom and reported a diagnosis of depression in the previous year.

Covariates:

Demographic variables included the following: Age at recruitment (18+ years); gender; country of residence (Canada, USA, UK, or Australia); education and income, both categorised according to appropriate criteria within each country, equating to low, moderate or high. A small minority of participants (between 6% and 7%) refused to answer their income but were retained in a separate category of ‘Refused’.

Nicotine dependence was assessed at each wave using the Heaviness of Smoking Index [35], ranging from 0 to 6 (HSI). Based on: number of cigarettes smoked per day (coded 0: 0–10 cigarettes per day (CPD), 1: 11–20 CPD, 2: 21–30 CPD, 3: 31+ CPD), and time to first cigarette (coded: 0: 61+min, 1: 31–60 min, 2: 6–30 min, 3: 5 min or less).

Recent quitting, a known predictor of subsequent attempts [36], was defined as reporting a quit attempt in the past year at T1.

Intent to quit smoking was assessed by “Are you planning to quit smoking: 1 = ‘within the next month’, 2 = ‘within the next 6 months’, 3 = ‘sometime in the future, beyond 6

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months' or 4 = 'or are you not planning to quit?' It is associated with the likelihood of making a quit attempt but not the outcome [37,6].

Quitting self-efficacy was assessed with "If you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed? (from 1 = 'not at all sure' to 5 = 'extremely sure') which was recoded into three categories: 1 = 'not at all sure', 2 = 'slightly to moderately sure' and 3 = 'very to extremely sure'.

Beliefs about the impact of smoking on health and quality of life were assessed by four questions, all on 4 point scales: "To what extent, if at all, has smoking damaged your health?" and "To what extent, if at all, has smoking lowered your quality of life?"; recoded to: 1= 'not at all', 2 = 'just a little', and 3 = 'a fair amount/ a great deal'); "How worried are you, if at all, that smoking will damage your health in the future?" and "How worried are you, if at all, that smoking will lower your quality of life in the future?" (from1 = Not at all worried, to 4 = 'very worried').

Support for attempts to quit smoking was measured retrospectively at T2. At waves 6 and 7, questions were asked to elicit whether participants had used any stop-smoking medications, and whether they had received advice or information about quitting smoking from telephone quit lines, the Internet, local stop smoking services, since the last survey. This was changed slightly at wave 8, they were first asked about any support used on their most recent attempt (if relevant) and if they said "No" or had not made a quit attempt they were asked about support at any time. Two separate binary variables were derived to indicate whether participants had used any stop-smoking medication and behavioural support.

Outcome variables:

Quit attempts were assessed at T2 by "Have you made any attempts to stop smoking since we last talked with you?

One month abstinence: Those who had made a quit attempt were also asked about the length of their current or most recent quit attempt; dichotomised into quit for 1-30

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days and 31 days or more. Where possible, participants surveyed at T2 who had not yet quit for at least a month were followed up at the next survey wave (107 quit attempts) and quit length verified.

Analysis strategy

Three sets of analyses were conducted: 1) predictors of quit attempts; 2) among those who tried, predictors of one month abstinence; 3) an overall analysis of predictors of one month abstinence among all participants. The direction and significance of the main effects were first examined within each of the three wave pairs separately with chi-square tests for independence, and were found to have consistent effects across waves.

Prior studies from the ITC project have found that quit rates may differ between countries [37]. We used mixed-effects logistic regression (MELR) models to account for clustering of outcomes by individual (repeated measures) and by country. Mixed effects models contain both fixed and random effects. The inclusion of random effects for individual and country allows for a subject- and country-specific interpretation of the fixed effect of depression on quit attempts and abstinence. We compared 3 mixed-effects models using likelihood ratio tests with significant alpha at $p < 0.05$ and Akaike's Information Criterion: 1) A random intercept for individuals; 2) We added a random intercept for country; 3) Because we cannot assume that the effect of depression is consistent across countries, we added a random effect for depression by country to investigate potential between-country heterogeneity in the effect of depression. Depression was treated as a categorical variable in both the fixed and random effects. The data was analysed with STATA 14.

For testing the effects of depression on quit attempts and abstinence, we were primarily interested in the fixed effects component of our models, adjusting for individual and country clustering. Hypotheses were tested by entering co-variates in pre-determined steps to test for possible mediating and moderating effects. Model 1

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included demographics and survey wave. Model 2 added the HSI, recent quitting history, intention to quit, self-efficacy, and the four beliefs about smoking's impact on health and quality of life. For abstinence among those making attempts, model 2 did not include intention. A third model tested effects of support to quit smoking (medication and psychosocial), only controlling for demographics and survey wave. All covariates were assessed at T1 (or at recruitment, e.g. sex), except for support to quit smoking which was measured retrospectively at T2. We tested interactions between the depression variable and gender for both quitting outcomes, and between depression and use of supports to quit smoking for one month abstinence among those who tried. The design consists of three predictor waves (T1: 5, 6, and 7) and three outcome waves (T2: 6, 7, and 8). Thus, the same participants who provided multiple observations could be classified as symptomatic at one wave and asymptomatic at the next wave. There were very low rates of missing data across all variables included in this study, mostly less than 1%.

Results

Table 1 shows the sample demographics, quitting behaviours and the proportion in each category of the depression variable at each wave. Sample characteristics remained stable across survey waves, with the exception of reported quit attempts which increased at each wave, and fewer participants reporting either symptom at wave 7.

Participants who reported neither symptom were more likely to be older, male and have high income and high education. Having low income and low education was marginally associated with reporting either symptom. Female gender, low income and low education were clearly characteristic of those reporting a diagnosis of depression in the previous year.

Table 2 shows the variation in associations between the depression indicator variable and each of the covariates, with the lowest and highest of the three waves.

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All were significant, except for self-efficacy at wave 7, pharmacological support at wave 5, and behavioural support at waves 5 and 6.

To select the best fitting MELR model, we compared a model that included a random intercept for individuals with a model that also included a random intercept for country and found the latter was better (e.g., LR chi2 = 24.31, p<0.001 in analyses predicting abstinence among quitters). We then compared the second model with a third model that also included a random coefficient for depression by country and generally found no significant improvement in model fit (e.g., LR chi2 = -41.1, p = 1.00 in analyses predicting abstinence among quitters), indicating there was no significant between country heterogeneity in the effect of depression on quitting outcomes. Odds ratios reported here are for the fixed effects estimates from MELRs with random intercepts for individual and country, except in one instance where some between-country heterogeneity in the association between depression and attempts was found (see below).

Quit attempts

Table 3 shows the results of the MELRs for quit attempts. There was a significant interaction between gender and depression symptoms in the first model (p = 0.018). With all covariates in the model, the interaction was not significant (p = 0.181). Results are shown separately for the sample as a whole (column 1) and for each gender (columns 2 and 3). Compared to those who reported being symptom free, reporting either symptom or a recent diagnosis was significantly associated with increased odds of making a quit attempt. Among men, reporting either symptom or a recent diagnosis was significantly associated with making a quit attempt. The effect was weaker among women, only those who reported a recent diagnosis were significantly more likely to try and quit. This effect persisted after controlling for demographics, but was no longer significant in model 2. Intention and recent quitting history, and to a lesser extent concerns about impact of smoking on health and

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quality of life, replaced depression as predictors (see supplementary Table 1; covariates were in the expected directions for each of the quitting outcomes).

When all covariates were included in the model for quit attempts, we found that including a random coefficient for depression at the country level significantly (but marginally) improved the model (LR chi2 = 4.23, p = .040), indicating that there was some variability between countries in the association between depression and making a quit attempt. The results for each country separately are shown in supplementary Table 2. There was a significant negative association between reporting depressive symptoms and making a subsequent quit attempt in the USA for both genders combined on model 2. We also found a gender by depression interaction in Australia on model 1 ($p < .001$) and model 2 ($p = 0.003$). Reporting depressive symptoms (more so than a diagnosis) was positively associated with quit attempts among men and negatively among women (see supplementary Table 2).

One month abstinence

For one month abstinence among those who tried to quit (Table 4), compared to those reporting being symptom free, having at least one symptom was negatively associated with one month abstinence, with a stronger negative relationship for a reported diagnosis. The interaction between gender and depression was borderline significant at $p = 0.049$ in model 1 and close to significance in model 2 ($p = 0.098$), so the by-gender results are also shown. The direction of effect of depression on abstinence was the same for men and women. However, only reporting a diagnosis was significant for men, but not in model 2. Among women, depressive symptoms were negatively associated with one month abstinence, unaffected by the addition of covariates.

In model 3 we found no effect of adding use of help on the deficit in quit success. We note that behavioural support was not significantly associated with abstinence (OR = 1.09, 95% CI = 0.90-1.31) but pharmacological support was (OR = 1.37, 95% CI =

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1.17-1.61). The interactions between depression and use of behavioural (p = .424) and pharmacological (p = 0.193) cessation support were not significant.

Finally, considering abstinence as a function of all participants (see supplementary Table 3), the interaction between gender and depression was significant with all covariates added at model 2 (p = 0.005). Among women, reporting at least one symptom or a recent diagnosis was negatively associated with achieving one month abstinence in both models. A different pattern was observed among men, where a marginal non-linear main effect disappeared after controlling for the psychosocial predictors.

Discussion

Smokers with signs of depression were generally more likely to make quit attempts, but perhaps not in the USA. Furthermore, men were more likely to make attempts than women, particularly in Australia. In all cases the size of effects decreased, disappeared or became negative when controlling for motivational and other measures, suggesting that some of these variables mediated attempting. Also, as hypothesized, among those who tried to quit, depressive symptoms or diagnosis predicted relapse with this effect unmediated by motivational variables or use of cessation help, and clearest in women, with no by-country differences. The combination of these two effects meant there was little overall relationship between depression and quitting for a month among men, only being apparent for those who reported a diagnosis when controlling for most covariates, but a strong and consistent relationship for women.

Women reported a diagnosis of depression at a higher rate than men, consistent with other research [39]. The stronger association of depressive symptoms with adverse quitting outcomes among women can be used as further evidence that the gender difference is real and not due to greater tendency to report disturbed mood. The findings are supported by recent evidence that women tend to relapse at higher rates than men [40,41], that women evidence greater associations between smoking

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and depression in large epidemiological samples [30], and that depression predicts relapse [17,42,43]. The results of this study suggest that the risk of relapse is greater for women with depression than men with depression, and that the use of behavioural support or medication does not mitigate the effect. The mechanism for this relationship is not clear. It has been suggested that women are more likely to smoke to manage negative affect [44], endorse beliefs that smoking alleviates negative affect [45], and report greater concern about managing negative affect after quitting [46], all increasing the risk of relapse, particularly in women with depression.

The by-country differences in the effect of depression on making quit attempts are hard to explain. In all cases the effects decreased when controlling for psychosocial variables, ones which may be affected more by the prevailing social conditions and extent of anti-smoking activity. It may be some difference in societal expectations on depressed people, but we have no clear idea as to what these might be. They may also represent chance effects.

The general finding of increased quitting among people with signs of depression does not support a helplessness model of depression, which would predict less quitting activity. Those with depression were also more worried about smoking's impact on their current and future health and quality of life. When these relationships were controlled for, depression did not generally predict quit attempts.

People with depression tend to have biased attention towards negative circumstances and predict negative outcomes. While this is often distorted, it is sometimes an accurate appraisal of their situation, or "depressive realism". Given that motivational variables independently predict depressive symptoms, they can be considered partial mediators of the effects. A possible interpretation of these findings is that smokers with depression have heightened awareness and worry over smoking's negative impact on them, helping to motivate more quit attempts.

The implications of this study should be interpreted with some caution. Our interpretations of the interactions are based on results that were, in some cases,

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non-significant trends and needs replication. We believe that in the context of the existing literature, signs of depression do predict relapse, but more evidence is needed as to whether depression actually stimulates making attempts, and if so, under what circumstances. One alternative to a causal explanation is that holding strong beliefs/expectations about smoking's damage to health and quality of life contributes to both depressive symptoms and the motivation to make a quit attempt. We also note that our indicator of depression was used to prospectively predict quit attempts that occurred between baseline and follow-up (approximately 12 months). Therefore, we are unable to infer whether participants were experiencing symptoms of depression at the time a quit attempt was made. We also did not measure lifetime history of depression, a predictor of cessation failure in some studies [43,9,47] but not others [11,12].

Participants were asked to recall their quit attempts since baseline and as some forgetting occurs, particularly of failed (shorter) attempts, it is possible that smokers with depression are more likely to remember their failures than non-depressed smokers. This is a possible alternative explanation for the findings on quit attempts; however, our finding of a mediating effect of motivation and moderating effect of gender were more consistent with a real effect of depression on quitting outcomes than an artefact of recall bias. The finding of no differential benefit of cessation also should be treated with caution. We may have shown an effect if we had assessed more intensive support.

A strength of this study is the longitudinal cohort design with a large number of participants, and our analyses using mixed effects logistic regression were designed to take advantage of this. Consequently, we were able to look at the predictors of quit attempts separately from abstinence. We found significant and consistent associations among the covariates and depression, and the outcome variables, at all three waves, suggesting that our findings are robust. Furthermore, the two depression screener questions have been found to reliably predict a clinical diagnosis of depression [34]. A further strength is finding effects of depression on

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abstinence that are consistent across four countries, although we found some evidence of between-country heterogeneity in the effect of depression on quit attempts in one of our models. That said, generalisation to other countries should be only done with caution, especially to smokers from countries that differ from those studied in terms of cultural factors, economic development, or extent of tobacco control efforts.

Overall, this study indicates that smokers with depression are motivated to quit smoking, and they make quit attempts at a higher rate than their non-depressed counterparts. This latter finding may be mediated by increased motivation to quit driven by concern for one's health. Even if the finding of greater quitting is not found consistently, it is implausible that quitting activity is significantly lower. That signs of depression are associated with increased activity is inconsistent with models of depression that focus on a generalised motivation to act; it may be that any such deficit is restricted to instrumental activities, not health protective ones. The weak gender effect found here might be in part caused by the greater difficulty women have in remaining quit, and thus reflect a hangover from repeated past failures.

More consistent with past research, depression is a risk factor for relapse in the first month of a quit attempt, particularly among women, but the reasons for this remain unclear. These findings have implications for clinicians and researchers wanting to help smokers with depression successfully quit smoking. Clinicians should be aware that people who have depression appear more motivated to try to quit than the rest of the population but are more likely to relapse. Thus they may need greater support to sustain abstinence in the early stages of a quit attempt. However, current interventions do not eliminate the imbalance, but do improve their chances of success. More research is needed on the moderating role of gender on the relationship between depression and smoking cessation, and on which country-specific cultural features most encourage action. There is a case for developing gender-sensitive cessation interventions to help female smokers with depression overcome what may be greater obstacles to success.

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Table 1. Sample characteristics at each wave.

	Wave 5 to 6 n = 4434	Wave 6 to 7 n = 4535	Wave 7 to 8 n = 3507
Mean inter-survey interval in days	335 (sd =39.8)	393.9 (sd =49.7)	600.5 (sd =60.9)
Gender			
Female	57.6%	57.2%	56.0%
Age (mean no. years)	46.6 (sd =13.1)[a]	47.5 (sd =12.7)[a]	48.3 (sd =12.6)[a]
Income			
Low	30.0%	29.1%	29.0%
Moderate	34.3%	33.2%	32.3%
High	29.8%	31.1%	31.8%
Refused	5.9%	6.7%	7.0%
Education			
Low	53.0%	51.9%	52.2%
Moderate	30.9%	31.2%	30.5%
High	16.1%	17.0%	17.3%
Country			
Canada	25.2%	26.0%	25.8%
USA	22.9%	23.6%	22.6%
UK	24.8%	23.6%	26.7%
Australia	27.1%	26.8%	25.0%
Heaviness of Smoking Index (mean)	2.8 (sd =1.5)	2.9 (sd =1.5)	2.8 (sd =1.5)
Made a quit attempt between waves*			
Yes	36.2%	37.5%	43.5%[b]
One month abstinence (among those who tried to quit)*			
Yes	46.1%	45.7%	46.8%
Depression variable			
Reported neither symptom	56.1%	56.5%	63.5%[b]
Reported either symptom, no depression diagnosis	29.8%	30.0%	24.4%[b]
Reported depression diagnosis in last year	14.1%	13.5%	12.1%

*Measured at the follow-up survey.
a: indicates a significant trend $p < .05$
b: indicates a significant difference to the other two waves.

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Table 2. Bivariate associations between the depression indicator variable and each covariate. This table shows the range (lowest to highest) of percentages within each variable across waves.

	No depression W5 n=2488, W6 n=2561, W7 n=2228	**Reported either symptom** W5 n=1323, W6 n=1362, W7 n=855	**Reported diagnosis** W5 n=623, W6 n=612, W7 n=424	***Overall trend with greater signs of depression***
HSI (mean)	2.7 - 2.8	2.8 - 2.9	3.2 - 3.2	Increasing
Quit attempt between surveys[†] %	34.7 – 39.7	37.6 – 49.5	39.8 - 51.2	Increasing
One month abstinence for those who tried[†] %	48.6 – 51.8	42.3 – 45.7	34.4 – 36.1	Decreasing
Intention %				
Not planning to quit	34.5 - 38.1	23.3 - 25.8	23.9 - 28.1	Increasing
Beyond 6 months	34.2 - 36.1	38.8 – 39.7	36.8 - 38.0	
Within the next 6 months	18.3 - 21.6	23.5 - 25.9	23.0 - 26.0	
Within the next month	7.6 - 9.1	11.0 - 13.8	10.1 - 12.5	
Self-efficacy* %				
Not at all sure	31.6 - 34.2	32.7 - 35.0	38.4 - 41.0	Decreasing
Slightly to moderately sure	47.3 - 49.7*	47.7 - 50.7	44.1 - 45.8	
Very to extremely sure	16.1 - 19.3	16.3 - 17.3	14.4 - 15.9	
Recent quit attempt (at T1) %	25.9 – 29.3	35.8 – 37.3	37.4 – 40.5	Increasing
Smoking has damaged your health %				
Not at all	23.8 - 26.8	14.3 - 16.2	11.6 - 14.7	Increasing
Just a little	47.6 - 50.3	43.2 - 44.4	33.7 - 38.7	
Fair amount – great deal	22.9 - 28.6	39.9 - 41.5	46.6 - 53.3	
Smoking will damage your health %				
Not at all worried	18.3 - 20.5	8.7 - 11.8	10.3 - 15.6	Increasing
A little worried	32.2 - 34.3	24.4 - 28.5	22.0 - 25.0	
Moderately worried	28.3 - 31.0	29.9 – 33.1	24.6 - 28.1	
Very worried	15.5 - 20.3	29.9 - 32.8	35.3 - 43.2	
Smoking has lowered QOL %				
Not at all	49.9 - 55.5	27.5 - 34.2	25.0 - 27.6	Increasing
Just a little	32.7 - 36.0	38.5 - 41.1	28.8 - 34.8	
Fair amount – great deal	10.8 - 14.8	27.0 - 32.3	37.6 - 45.1	
Smoking will lower QOL %				
Not at all worried	26.3 - 28.6	13.2 - 17.0	13.3 - 16.7	Increasing
A little worried	33.4 - 37.0	28.1 - 30.3	24.1 - 25.8	
Moderately worried	21.3 - 23.9	26.4 - 29.4	23.0 - 27.8	
Very worried	12.9 - 16.8	26.3 - 29.4	31.8 - 39.0	
Stop smoking medication (those who tried)[†] %				
Yes	50.2* - 52.5	48.9* - 54.2	51.2* - 66.4	No trend
Behavioural support (those who tried)[†] %				
Yes	18.0* - 27.5	19.1* - 29.6	20.1* - 38.4	Increasing

[†] - Measure taken from follow-up survey. * - Not significant p > .05

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Table 3. Mixed effects logistic regressions predicting a quit attempt between waves T1 and T2, fixed effects adjusted odds ratios for the depression variable, controlling for covariates at each model.

	Combined **n respondents = 6811** **n observations = 12476**	**Men** **n respondents = 2957** **n observations = 5361**	**Women** **n respondents = 3854** **n observations = 7115**
Model 1 – Demographics*			
Not bothered by either symptom	Reference	Reference	Reference
Bothered by either or both NA or LPA	**1.22 (1.08 – 1.38)**	**1.51 (1.24 – 1.84)**	1.05 (0.89 – 1.23)
Reported diagnosis of depression in last year	**1.34 (1.13 – 1.59)**	**1.39 (1.01 – 1.92)**	**1.29 (1.05 – 1.59)**
Model 2 – Demographics, HSI, and motivational variables**			
Not bothered by either symptom	Reference	Reference	Reference
Bothered by either or both NA or LPA	0.95 (0.83 – 1.08)	1.01 (0.82 – 1.25)	0.89 (0.76 – 1.03)
Reported diagnosis of depression in last year	1.00 (0.86 – 1.17)	0.99 (0.76 – 1.30)	1.01 (0.85 – 1.21)

NA = Negative affect & LPA = Low positive affect. Bold text = p <.05.
Model 1: Includes survey wave and demographics (gender, age, country, income and education). * This model includes a random intercept at the individual level and a random intercept at the country level.
Model2: Includes survey wave, demographics, HSI, recent quit attempt, intention, self-efficacy and the four beliefs about smoking's impact on health and quality of life. ** This model includes an additional random coefficient for depression at the level of country.

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Table 4. Mixed effects logistic regressions predicting one month abstinence among those who made a quit attempt between T1 and T2, fixed effects adjusted odds ratios for the depression variable, controlling for covariates at each model*.

	Combined **n respondents = 3558** **n observations = 4697**	**Men** **n respondents = 1474** **n observations = 1925**	**Women** **n respondents = 2084** **n observations = 2772**
Model 1 – Demographics			
Not bothered by either symptom	Reference	Reference	Reference
Bothered by either or both NA or LP	**0.71 (0.60 – 0.85)**	0.91 (0.72 – 1.17)	**0.58 (0.45 – 0.75)**
Reported diagnosis of depression in last year	**0.48 (0.38 – 0.61)**	**0.67 (0.45 – 0.98)**	**0.38 (0.28 – 0.53)**
Model 2 – Demographics, HSI, and motivational variables			
Not bothered by either symptom	Reference	Reference	Reference
Bothered by either or both NA or LP	**0.77 (0.65 – 0.92)**	0.98 (0.76 – 1.26)	**0.63 (0.49 – 0.81)**
Reported diagnosis of depression in last year	**0.57 (0.45 – 0.72)**	0.74 (0.50 – 1.10)	**0.46 (0.34 – 0.63)**
Model 3 – Demographics and support to quit smoking			
Not bothered by either symptom	Reference	Reference	Reference
Bothered by either or both NA or LP	**0.71 (0.60 – 0.85)**	0.92 (0.72 – 1.17)	**0.57 (0.44 – 0.74)**
Reported diagnosis of depression in last year	**0.47 (0.37 – 0.60)**	**0.64 (0.43 – 0.94)**	**0.37 (0.27 – 0.52)**

NA = Negative affect & LPA = Low positive affect. Bold text = p <.05.
*Each model includes a random intercept at the individual level and a random intercept at the country level.
Model 1: Measures were the same as Table 3.
Model 2: Measures were the same as Table 3 (excluding intention).
Model 3: Support measures were pharmacological and behavioural smoking cessation support.

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