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Change in anxiety following successful and unsuccessful attempts at smoking cessation: cohort study

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Abstract

Background Despite a lack of empirical evidence, many smokers and health professionals believe that tobacco smoking reduces anxiety, which may deter smoking cessation. Aims The study aim was to assess whether successful smoking cessation or relapse to smoking after a quit attempt are associated with changes in anxiety. Method A total of 491 smokers attending National Health Service smoking cessation clinics in England were followed up 6 months after enrolment in a trial of pharmacogenetic tailoring of nicotine replacement therapy (ISRCTN14352545). Results There was a points difference of 11.8 (95% CI 7.7-16.0) in anxiety score 6 months after cessation between people who relapsed to smoking and people who attained abstinence. This reflected a three-point increase in anxiety from baseline for participants who relapsed and a nine-point decrease for participants who abstained. The increase in anxiety in those who relapsed was largest for those with a current diagnosis of psychiatric disorder and whose main reason for smoking was to cope with stress. The decrease in anxiety on abstinence was larger for these groups also. Conclusions People who achieve abstinence experience a marked reduction in anxiety whereas those who fail to quit experience a modest increase in the long term. These data contradict the assumption that smoking is a stress reliever, but suggest that failure of a quit attempt may generate anxiety.

Keywords

study, cohort, cessation, anxiety, smoking, change, attempts, unsuccessful, successful, following

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Change in anxiety following successful and unsuccessful attempts at smoking cessation: a cohort study

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ABSTRACT

Background

Despite a lack of empirical evidence many smokers and health professionals believe that tobacco smoking reduces anxiety, which may deter smoking cessation.

Aims

The study aim was to assess whether successful smoking cessation or relapse to smoking after a quit attempt are associated with changes in anxiety.

Method

A total of 491 smokers attending NHS smoking cessation clinics in England were followed up six months after enrolment in a trial of pharmacogenetic tailoring of nicotine replacement therapy.

Results

There was an 11.8 (95% confidence intervals: 7.7 to 16.0) points difference in anxiety score six months after cessation between people who relapsed to smoking and people who attained abstinence. This reflected a three point increase in anxiety from baseline for relapsers and a nine point decrease for abstainers. The increase in anxiety in relapsers was largest for those who had a current diagnosis of psychiatric disorder at baseline and whose main reason for smoking was to cope with stress. The decrease in anxiety on abstinence was larger for these groups also.

Conclusions

People who achieve abstinence experience a marked reduction in anxiety while those who fail to quit experience a modest increase in the long-term. These data contradict the assumption that smoking is a stress reliever, but suggest that failure of a quit attempt may generate anxiety.

Declaration of interest

Paul Aveyard has done consultancy and research on smoking cessation for pharmaceutical companies.

INTRODUCTION

The belief that smoking alleviates anxiety, or stress as it is commonly known in the general population, (i.e. is anxiolytic) is highly pervasive. Almost half the smokers in England cite stress relief as one of the main reasons for smoking (1). This stands in contrast to the evidence from numerous laboratory studies that fail to detect mood enhancing effects of nicotine (2). Smoking appears not to reduce stress in smokers who are not nicotine deprived; instead, levels of stress in smokers after smoking are similar to those of non-smokers (3). It has been suggested, therefore, that the perceived beneficial effects of smoking upon stress are actually a misattribution of withdrawal relief (4, 5). There is further research to suggest that smoking may actually be a risk factor for the development of anxiety-related disorders (6). Findings such as these suggest that smoking may actually *cause* stress, whilst fostering the impression in smokers that it alleviates stress, due to nicotine's ability to quickly reverse the symptoms of withdrawal (7). The belief that smoking relieves stress serves as a major barrier for smokers to quit (8), and for health professionals to recommend quitting. Health professionals also believe that smoking is anxiolytic and that smoking cessation worsens mood (9, 10). This belief is particularly detrimental to those with psychiatric disorders, who are less likely than other smokers to be offered cessation advice and support (11), despite having a life expectancy around 20 years lower than people without such a disorder. Much of this loss is attributed to cigarette smoking (12), which is more prevalent in this group (13).

Although it is well documented that anxiety tends to increase in the first few days of a quit attempt due to withdrawal from nicotine (14), it remains unclear what happens in the longer term once the initial withdrawal phase has ended (normally after 2-4

weeks) (14). Two studies report associations between prolonged abstinence and reduced stress (7, 15). These are limited, however, by small sample sizes, lack of sample representativeness and lack of validated measures of anxiety. Evidence in populations with psychiatric disorders is even more limited, although indirect evidence refutes assertions of a negative impact. A systematic review of enforced smoking bans in inpatient psychiatric settings found no evidence of increased aggression, use of seclusion, discharge against medical advice or increased use of as-needed medication following the ban (16), although the review did not record whether inpatients actually stopped smoking or not.

The current paper aims to build on these findings using more rigorous methods. The sample for the current study is drawn from general population smokers and uses validated measures of key outcomes (anxiety and smoking status) and hypothesized moderators (current diagnosis of psychiatric disorder and motivation to smoke for coping as opposed to pleasure). Furthermore, the study represents, to our knowledge, the first assessment of the effect of quitting smoking on anxiety amongst those with a current mental disorder and the first investigation into the long-term consequences of failing to quit smoking on mental health. This is important because most people who try to quit smoking fail to achieve abstinence on any single quit attempt and require multiple attempts. If failed attempts were harmful to mental well-being, there would be even more imperative to ensure that the chances of success were maximised with available effective interventions. A recent study of people with a history of clinical depression reported that both depression and anxiety scores deteriorated in a quit attempt following relapse to smoking (17). This may suggest a concern, but the follow up was less than 3 months and most results were not statistically significant.

The data are therefore inconclusive. The primary aim of this study is to assess changes in smokers' anxiety following a quit attempt in those that succeeded in remaining abstinent (abstainers) and those that relapsed (relapsers). We also examine whether the changes associated with abstinence are modified by the presence of a current diagnosis of psychiatric disorder and by whether smoking for stress relief was a prime motive for smoking.

METHODS

Study design

Prospective cohort study involving secondary analysis of data from a smoking cessation trial (details of the trial are published elsewhere (18) (19)). Ethical approval for the trial was granted (Hertfordshire 1 Research Ethics Committee, reference 06/Q0201/21) and the local primary care trusts in Birmingham and Bristol gave approval for the interventions. Additionally, the Medicine and Healthcare Products Regulatory Authority gave approval (MHRA ref: 24570/0002/001-0001).

Recruitment

Participants were recruited from the practices of 29 primary care physicians in two English cities to participate in an open label, parallel group, randomized controlled trial conducted in primary care. Participants smoking at least 10 cigarettes a day, who wanted to quit and were 18 years or older were eligible for inclusion. Potentially eligible participants were identified from practice registers and mailed a letter from their primary care physician expressing concern about their smoking and offering assistance to quit, with an invitation to participate in the trial. Informed written consent was obtained from all participants involved in the study. A total of 633 agreed to participate in the trial and were randomized, of whom 491 provided data at both baseline and six months for the measure of state anxiety. Recruitment began in June 2007 and all data collection was completed by September 2009.

Interventions

The trial took place in United Kingdom National Health Service (NHS) smoking cessation clinics based in primary care. These provide a combination of behavioural

support, education and pharmacotherapy to assist smokers to quit. All participants were prescribed a nicotine patch with the dose based on heaviness of smoking. Those who smoked 15 or more cigarettes a day were prescribed 21mg patches and those smoking 10-14 cigarettes a day were prescribed 14mg patches. In addition, participants were randomized to receive an additional oral NRT dose, based either on their genotype (genotype arm) or nicotine dependence (phenotype arm), either of 6mg or 12mg a day.

Procedure

Participants attended eight weekly clinic appointments with a research nurse. In the first clinic session participants completed baseline measures –including anxiety. Participants started their quit attempts either immediately following the third clinic visit or the following morning. At this appointment the rationale for participants' additional oral NRT doses, based on the group to which they had been randomized, was given. All participants were contacted six months following their quit dates, either by telephone or by post. Follow-up questionnaires were completed and, in those indicating continued abstinence, a salivary sample was requested by post and subsequently analysed for cotinine.

Measures

Anxiety: Anxiety was measured using the six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI-6 (20)). This measure has high internal reliability (α=.89 and .75 for T1 and T3 respectively) and is a validated short form of the original 20-item state scale of the STAI (21, 22). Scores range from 20 to 80 with a population norm of 35.

Smoking status: Prolonged abstinence from smoking at six months, defined as sustained abstinence after an initial two week grace period, was assessed using self-reported behaviour with biochemical validation as recommended for clinical trials (23). Participants were considered to be prolonged abstinent if they reported that they had smoked no more than five cigarettes since the start of the abstinence period, and had a salivary cotinine level of less than 15ng/ml. Initial abstinence from smoking at four weeks was assessed as per usual clinic practice after quit date with self-reports of abstinence validated by expired-breath carbon monoxide (CO) reading assessed using a Bedfont Smokerlyzer (Rochester, UK). Participants were considered to be abstinent if they reported not smoking a single puff during the previous week and had a CO reading of ≤9 parts-per-million and all others considered as relapsers. In each case, non-responders or invalidated self-reports of behaviour were counted as smoking.

Motives for smoking: Motives for smoking were assessed at baseline by responses to a single item 'Do you smoke mainly for pleasure or because it helps you to cope?' Participants were asked for one of three possible responses 'mainly for pleasure', 'mainly to cope' or 'about equal'. Those reporting smoking primarily for pleasure have been found to be significantly more likely to achieve abstinence than those reporting smoking primarily to cope (24).

Current diagnosis of psychiatric disorder: At baseline, participants were asked to report current medical history, including psychiatric disorders. If in doubt, these data were confirmed with the medical record held by the patient's primary care physician.

In addition, baseline data were collected on demographic characteristics (age, gender, ethnicity, socioeconomic status (assessed using educational qualifications) and nicotine dependence (assessed using the Fagerström Test for Nicotine Dependence (FTND (25)).

Statistical analyses

We used linear regression to examine anxiety at follow up in relation to smoking status, classified as relapsers and abstainers. Baseline STAI-6 (anxiety) score was mean-centred. For ease of interpretation, the anxiety score at follow up was centred on the baseline mean so that regression coefficients represented the change in anxiety score. All other continuous variables were mean-centred and all categorical variables entered as dummy-coded variables. We conducted complete-case analyses as rates of missing data were low (see Table 1).

In the initial model, only abstinence status and baseline anxiety score were entered. Thereafter, potential confounders were added; age, gender, ethnic group. In addition, variables that appeared unbalanced between abstainers and relapsers were also included; namely cigarettes per day, nicotine dependence score, trial arm, and dose of NRT used. We compared anxiety change score in relapsers and abstainers (adjusted only for baseline rating) with the fully adjusted estimates by calculating the latter using the mean of the various other covariates.

We examined whether having a current diagnosis of psychiatric disorder or motive for smoking modified the association between abstinence and change in anxiety score. To do so, we added both a term representing the presence of a current diagnosis of

psychiatric disorder (for example) and its multiplicative interaction with abstinence and reported the F test for this step. Each term tests whether the change in anxiety differs from all other relapsers and abstainers.

People with a clinical diagnosis of anxiety disorder typically have a score of 50 or higher on the original 20-item state scale of the STAI (26). In order to create scores comparable with the larger scale, participants' raw scores on the STAI-6 (range = 6-24) were divided by 6 and multiplied by 20. Participants with scores ≥50 were classified as having high anxiety and the likelihood of being in the high anxiety group at follow up, conditional upon baseline group status was computed using conditional logistic regression.

RESULTS

Participant characteristics

We followed up 491/633 trial participants (77.8%) at six months. There was no difference in baseline anxiety between those who were and those who were not followed at six months (responders mean = 38.0 (SD=12.5); non-responders mean = 39.4 (SD=13.5), $t(612)=1.09$, p=0.28).

The participants were typical of smokers attending smoking cessation clinics (Table 1). Fourteen percent (n=68/491) were verified as prolonged abstinent at six months. Fifteen percent of abstainers (n=10/68) and twenty-two percent of continuing smokers (n=96/423) reported a current diagnosis of psychiatric disorder, with mood disorders being most common (Table 1). Mean baseline anxiety was within the normal range for subsequent abstainers and smokers, respectively.

INSERT TABLE 1 HERE

Association between change in anxiety and abstinence status

Adjusted for baseline STAI score, there was a significant difference of 12.3 (8.2 to 16.5) points in the STAI score between people who relapsed to smoking and those achieving prolonged abstinence. On further adjustment for age, dependence, cigarette consumption, and trial arm this difference was similar at 11.8 (7.7 to 16.0) points. This equated to an increase of about 3 points for those who did not achieve abstinence and a decrease of 9 points for those who did (both coefficients were individually statistically significant) (Figure 1).

There was reasonably strong evidence that adding terms that allowed the change in anxiety to depend upon the presence or absence of a current diagnosis of psychiatric disorder significantly improved the fit of the model (Table 2). The increase in anxiety in people without a current diagnosis was small (2 points, Figure 2) but greater among those with a current diagnosis of psychiatric disorder (7 points). The difference between these two groups was statistically significant (Table 2). Although the improvement in anxiety was greater among people with a current diagnosis of psychiatric disorder at baseline, this was not significant (p=0.19).

Change in anxiety was modified by motives for smoking, with the model fit improving significantly (Table 2). In people who relapsed, those smoking for enjoyment had no change in anxiety. Those who smoked either partly or mainly to cope had increases in anxiety (Figure 3). Likewise, the decrease in anxiety in those smoking to cope was larger than for the other two groups.

INSERT TABLE 2 HERE

Sensitivity analysis

The increase in anxiety upon relapse was somewhat unexpected, so we checked whether it might be a due to the participant having to declare relapse to researchers who had provided clinical treatment to assist cessation. We split relapsers into those who had failed during clinical treatment and therefore had already reported this to the research team and relapsers who returned to smoking after the end of treatment and were reporting relapse for the first time at six month follow up. Late relapsers reported a small, non-significantly lower rise in anxiety at 1.6 (-4.7 to 1.5) points.

Association between abstinence and case of anxiety disorder

At baseline 22.4% of participants were in the high anxiety group and at six months follow-up this had risen to 28.2%. People who would achieve prolonged abstinence were less likely to be in the high anxiety group at baseline, with only 14.7% meeting the definition, whereas 23.7% of people who would fail to quit were in the group. At follow up, the proportion of those in the high anxiety group among abstinent participants had fallen from 14.7% to 10.3%, whereas among continuing smokers it had risen from 23.7% to 31.0%. Considering the pairing, the odds ratio (OR) for being in the high anxiety group at six months among abstinent smokers was 0.63 (0.20, 1.91), whereas for relapsed smokers it was 1.58 (1.12, 2.24). The *p* value for the interaction between time and abstinence was 0.009. Three-way interactions between time, abstinence, and the presence of a current diagnosis of psychiatric disorder or smoking to cope failed to converge on a solution because of sparse data.

INSERT FIGURE 1 HERE

INSERT FIGURE 2 HERE

INSERT FIGURE 3 HERE

DISCUSSION

Quitting smoking was associated with a moderate reduction in anxiety, whilst relapse was associated with a small increase. The decrease in anxiety on abstinence was somewhat larger for people who had a current diagnosis of psychiatric disorder at baseline and also for people who smoked primarily to cope with stress, though it was significant only for the latter. The increase in anxiety was also larger for these groups, especially for the group that smoked primarily to cope.

This study had some strengths and limitations. Overall, the study was a relatively large smoking cessation study and recruited a representative sample of smokers seeking help to stop, without excluding people with co-morbid disorders. The frequent testing of abstinence in the first weeks after quit day and biochemical confirmation at each contact imply our key measure of exposure was accurate and the outcome was measured with a clinically relevant and validated scale. However, relatively few people abstained from smoking, meaning that sample sizes in some subgroups of abstainers were low, limiting precision and ability to detect associations. The most important limitation is that, like all observational studies, we cannot be sure that the associations we observed were caused by the change in smoking status. It would be practically difficult and ethically unacceptable to randomise people to abstain or continue smoking for six months. We therefore have to rely on data obtained from non-experimental studies to establish causality.

There is good evidence that stopping smoking is associated with reduced anxiety from both the current study and elsewhere (7, 15). In the current study the biggest predictor of anxiety at follow up was baseline anxiety, but the effect size for abstinence was

similar (betas 0.27 and 0.26 respectively). Furthermore, baseline anxiety scores were similar between abstainers and relapsers. Adjustment for a range of other potential confounders did not materially alter the strength of the associations. Although there are many reasons why anxiety might change over six months and which were not measured and therefore not controlled for, there is no reason to imagine that these would be differentially associated with abstinence status. Another explanation is reverse causation, namely that rising anxiety undermined the success of the quit attempt. We measured anxiety one week after quit day and neither anxiety measured then nor the change in anxiety at six months from baseline were associated with the likelihood of achieving abstinence. We also found that reporting relapse did not influence change in anxiety from baseline. The evidence for causality also comes from the consistency of these results with those from other studies (7, 15, 17) with no studies to our knowledge producing contrary results. Furthermore, there is a psychologically plausible mechanism- the misattribution hypothesis. There were data in this study that support this mechanism. Those experiencing the largest decrease in anxiety on cessation were the participants with a current diagnosis of psychiatric disorder and those who reported smoking to cope. Both these groups were more likely to report smoking within five minutes of waking (50% versus 39% and 50% versus 38% respectively). This is a behavioural marker of being driven to smoke to stave off withdrawal symptoms, which includes anxiety. By stopping smoking and removing these repeated episodes of anxiety, we might expect an overall reduction in reporting of anxiety, as observed.

In contrast, there is less strong evidence that the increase in anxiety on failure to quit smoking is caused by the change in smoking status. There is only one other report of

this to our knowledge (17). There is no obvious causal mechanism other than relapsers feeling concern arising from the continuing health risks of their smoking. However, we might expect this concern to return to baseline levels relatively soon after relapse, but there was no difference in six month increase in anxiety in early and late relapsers. Furthermore, almost all participants had tried to quit previously, so failure to attain abstinence was not a new experience. Nevertheless, there is no other obvious reason for the increase in anxiety and the increase seen in people who smoked to cope was clinically significant. This finding therefore warrants further attention given many smokers make repeated attempts to quit.

These findings have implications for public health messages about smoking. The belief that smoking is stress relieving is pervasive, but almost certainly wrong. The reverse is true: smoking is probably anxiogenic and smokers deserve to know this and understand how their own experience may be misleading. The finding on the rise in anxiety in smokers who fail to quit has less clear relevance for public health. It may be important for clinicians helping patients to stop smoking, particularly those with a current diagnosis of psychiatric disorder, who were more likely to report smoking primarily to cope than people who did not have a current diagnosis.

In summary, stopping smoking probably reduces anxiety and the effect is probably larger in those who have a psychiatric disorder and who smoke to cope with stress. A failed quit attempt may well increase anxiety to a modest degree, but perhaps to a clinically relevant degree in people with a psychiatric disorder and those who report smoking to cope. Clinicians should reassure patients that stopping smoking is

beneficial for their mental health, but may need to monitor for clinically relevant increases in anxiety among people who fail to attain abstinence.

DECLARATION OF INTERESTS

Paul Aveyard has done consultancy and research on smoking cessation for pharmaceutical companies. Máirtín McDermott, Theresa Marteau, Gareth Hollands and Matthew Hankins have no competing interests.

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CONTRIBUTORSHIP STATEMENT

MSMcD cleaned the data, contributed to the design and data analysis, drafted and revised the paper. TMM helped to devise the study, contributed to the design and data analysis, drafted and revised the paper. GJH & MH contributed to the design and data analysis and revised the draft paper. PA helped to devise the study, contributed to the design, analysed the data and revised the draft paper. He is guarantor for this study. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors approved the final version of the article.

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Table 1: Demographic characteristics, smoking-related variables, current psychiatric disorders, and motives for smoking

	Abstinent (n=68)	Relapsers (n=423)
Gender		
Male	35 (51.5)	186 (44.0)
Ethnic group		
White	64 (94.1)	380 (89.8)
Educational attainment		
No qualifications	23 (33.8)	119 (28.1)
GCSE or equivalent	15 (22.1)	103 (24.8)
A-levels or equivalent	8 (11.8)	47 (11.3)
Further education	7 (10.3)	55 (13.3)
Degree or other higher education	7 (10.3)	73 (17.6)
Other	8 (11.8)	26 (6.1)
Trial arm		
Genotype	43 (63.2)	211 (49.9)
NRT dose		
21mg patches	51 (75)	339 (80.1)
12mg equivalent daily dose[1]	6 (8.8)	96 (22.7)
Cigarettes per day (mean (SD))	18.7 (7.8)	21.0 (8.9)
FTND (mean (SD))	4.8 (2.0)	5.7 (2.2)
Treated for psychiatric disorder at baseline	10 (14.9)	96 (22.8)
Psychiatric disorders		
Mood disorders	5 (7.5)	51 (12.1)
Anxiety disorders	3 (4.5)	11 (2.6)
Other	2 (2.9)	34 (4.7)
Motives for smoking[2]		
Mainly for pleasure	19 (27.9)	85 (20.2)
Both	39 (57.4)	257 (61.2)
Mainly to cope	10 (14.7)	78 (18.6)

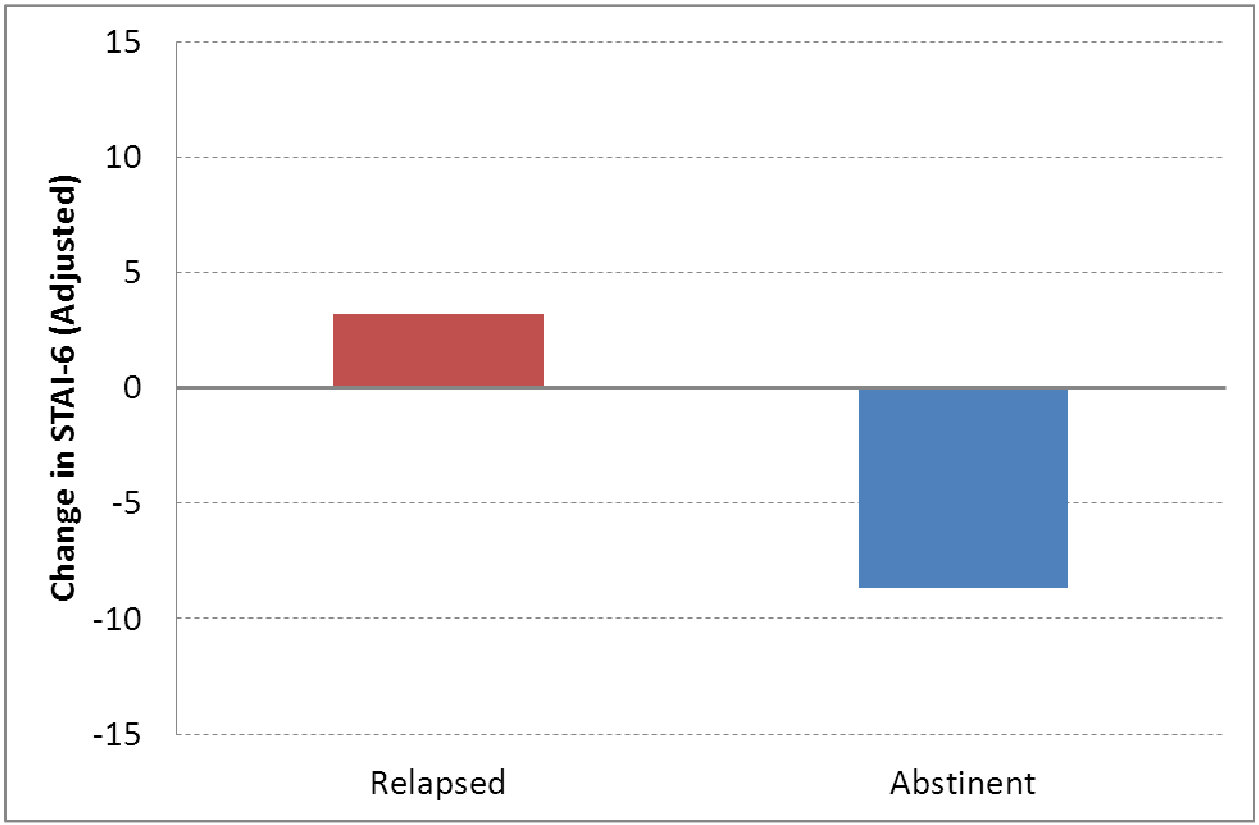
1 Equivalent daily dose is absorbed nicotine dose e.g. 12x2mg gum gives about 12mg absorbed dose
2 3 missing

Table 2 Improvement in model fit and coefficients for difference in change in anxiety score between those with and without a psychiatric disorder, or smoke for enjoyment

	F, df, p for improvement in model fit[1]	Partially adjusted[2]		Fully adjusted[3]	
		Adjusted coefficient	p value	Adjusted coefficient	p value
Has a psychiatric disorder	4.77, 2, 0.009				
Relapsed		5.9	0.002	5.2	0.007
Abstinent		-6.7	0.24	-7.4	0.19
Smoking motives	5.85, 4, <0.001				
Smoke for enjoyment and to cope, relapsed		5.1	0.009	5.4	0.006
Smoke for enjoyment and to cope, abstinent		-3.6	0.46	-3.2	0.50
Smoke to cope, relapsed		12.1	<0.001	11.1	<0.001
Smoke to cope, abstinent		-13.1	0.047	-13.6	0.037

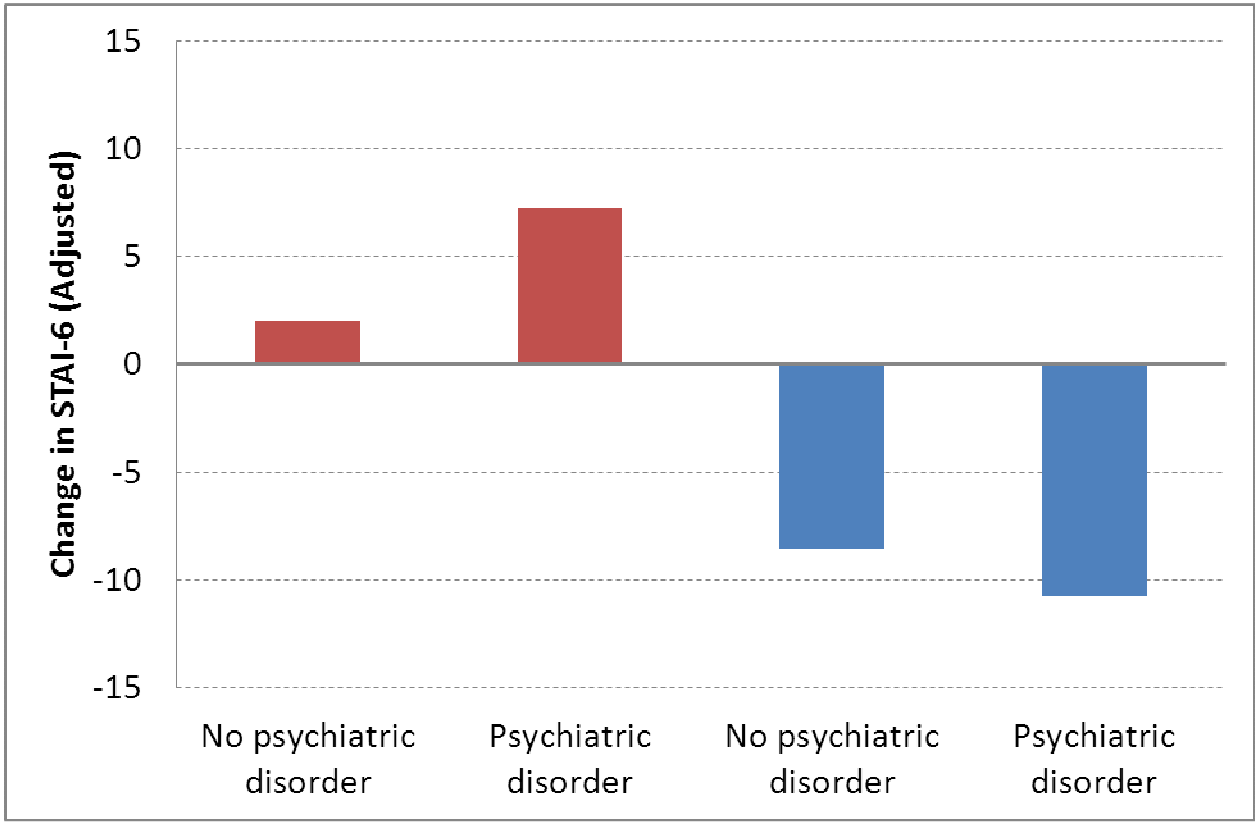
1 For addition of terms representing the presence of the characteristic and its interaction with smoking abstinence
2 adjusted for baseline anxiety score and smoking status
3 adjusted for baseline anxiety score, smoking status, age, gender, ethnic group, educational status, trial arm, and dose of NRT

Figure 1 Adjusted[1] change in anxiety from baseline to six months in relapsed smokers (red) and abstinent smokers (blue) overall



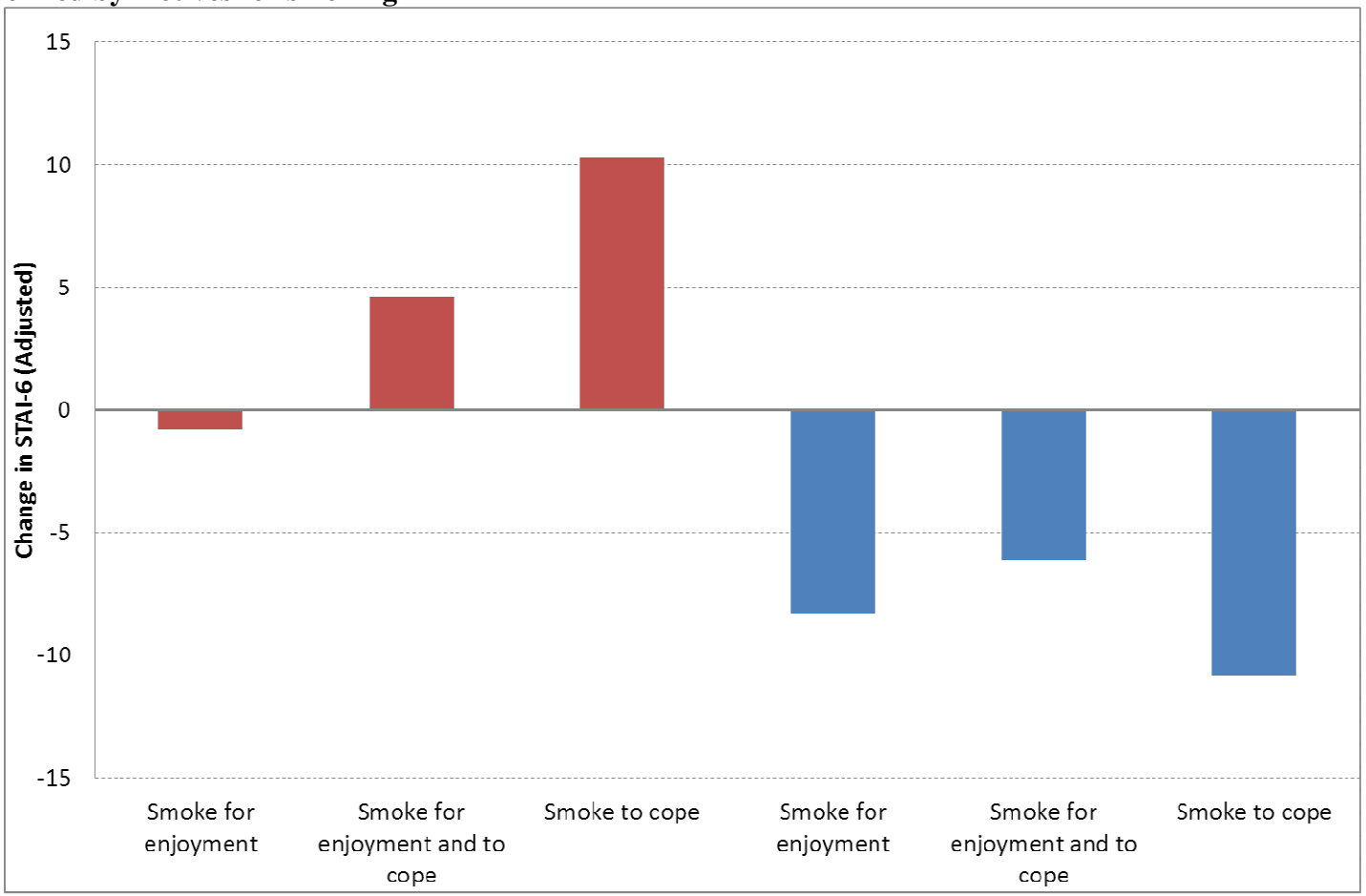
1 adjusted for baseline anxiety score, smoking status, age, gender, ethnic group, educational status, trial arm, and dose of NRT, all coefficients set to their means

Figure 2 Adjusted[1] change in anxiety from baseline to six months in relapsed smokers (red) and abstinent smokers (blue) by subgroups defined by psychiatric disorder



1 adjusted for baseline anxiety score, smoking status, age, gender, ethnic group, educational status, trial arm, and dose of NRT, all coefficients set to their means

Figure 3 Adjusted[1] change in anxiety from baseline to six months in relapsed smokers (red) and abstinent smokers (blue) by subgroups defined by motives for smoking



1 adjusted for baseline anxiety score, smoking status, age, gender, ethnic group, educational status, trial arm, and dose of NRT, all coefficients set to their means