

Louisa Degenhardt & Wayne Hall

**The relationship between tobacco use,
substance use disorders and mental disorders:
Results from the National Survey of Mental Health
and Well-Being**

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**The relationship between tobacco use,
substance use disorders and mental disorders:
Results from the National Survey of Mental Health and Well-Being**

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**NDARC TECHNICAL REPORT SERIES
ON THE
NATIONAL SURVEY OF MENTAL HEALTH AND WELL-BEING**

This is the third in a series of linked NDARC Technical Reports on various aspects of the National Survey of Mental Health and Well-being (NSMHWB). This survey was a major collaborative effort between numerous Australian academics and institutions. It was funded by the Mental Health Branch of the Commonwealth Department of Health and Aged Care. Fieldwork was conducted by the Australian Bureau of Statistics in 1997. It provides the first data on the prevalence and correlates of common mental health and substance use disorders among a representative sample of more than 10,000 Australians aged 18 years and over.

Each of these Technical Reports addresses separate issues related to findings on substance use disorders among Australian adults.

The list of Technical Reports on this topic published to date are:

Hall, W., Teesson, M., Lynskey, M. & Degenhardt, L. (1998). The prevalence in the past year of substance use and ICD-10 substance use disorders in Australian adults: Findings from the National Survey of Mental Health and Well-being (Technical Report No. 63).

Swift, W., Hall, W. & Teesson, M. (1999). Cannabis use disorders among Australian adults: Results from the National Survey of Mental Health and Wellbeing (Technical Report No. 78).

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EXECUTIVE SUMMARY

Tobacco is one of the most widely used psychoactive substances in the general population. The majority of Australian adults report having used tobacco at some point in their lives; and although many people report regular use, few perceive tobacco as a problematic drug.

There is considerable clinical evidence to suggest that tobacco use is more prevalent among persons in treatment for anxiety disorders, depression, and among persons with schizophrenia. Furthermore, there is evidence to suggest that persons with substance use problems are even more likely to smoke.

However, while these data suggest that people coming to the attention of treatment services have higher rates of smoking than the general population, clinical samples are subject to a number of selection biases. This means that although a relationship might exist in treatment populations, it may not be representative of the relationship in the general population. Although there has been some examination of the links between anxiety, depression and smoking using community surveys in the US, there has been no detailed examination of the relationship between tobacco use and mental health problems in the Australian population. Furthermore, there has been no epidemiological research examining the relationship between tobacco use and other substance use problems.

This report examined the associations in the Australian population between tobacco use, other drug use problems, and mental health problems. This was made possible using data from the 1997 National Survey of Mental Health and Well-Being, which was a representative sample of 10,641 Australian adults aged 18 years and over. The interview assessed tobacco use, DSM-IV anxiety, affective and substance use disorders, and screened for psychosis. There was also assessment of psychological distress and disability.

In addition to examining the simple associations between mental health problems, drug use problems, and smoking, a number of demographic variables were examined, as well as a measure of personality, the neuroticism scale of the EPQ. These variables were considered in a multivariate analysis, in addition to other drug use, to examine the possibility that univariate patterns were simply due to associated factors.

One in four persons (25%) reported current smoking. Males were slightly more likely to smoke than females (27% vs. 23%). Those who were younger were also much more likely to smoke, with 34% of 18-24 year olds currently smoking, compared to 8% of those aged 75 years and older.

Smoking was also related to a number of indicators of socioeconomic status. Those with less formal education were more likely to smoke, as were those who were unemployed, and had greater social disadvantage. Finally, those with higher levels of neuroticism (i.e. higher levels of moodiness, anxiety and irritability) were also more likely to be smokers.

Anxiety and affective disorders were more than twice as common among smokers, with around one in 10 smokers having an anxiety disorder (9.3%) and one in 10 (10%) having an affective disorder. In comparison, only around one in 20 non-smokers had an anxiety (4.5%) or an affective (5.4%) disorder. Those who reported current smoking were around 5 times more likely to screen positively for psychosis (95%CI 3.2, 6.8). Smokers also reported significantly higher levels of psychological distress

and disability due to emotional problems than non-smokers. These significant differences all remained even after the effects of demographic factors, neuroticism and other drug use were taken into account.

Substance use disorders were even more strongly related to smoking. Compared to non-smokers, current smokers were around 4 times more likely to have an alcohol use disorder (95%CI 3.4, 4.7), around 8 times more likely to have a cannabis use disorder (95%CI 5.7, 10.2), and 5 times more likely to have another drug use disorder (sedative, stimulant or opiate; 95%CI 3.1, 7.1). Again, these relationships remained significant even after accounting for demographics, neuroticism and other drug use.

These findings indicated that tobacco use is strongly related to mental health problems (as assessed with symptom measures or as mental disorders) and other substance use problems. These relationships persisted after accounting for a range of confounding variables.

Research has found that mental health problems reduce the likelihood of quitting smoking. Hence, it appears that there is a need to further examine interventions for smokers with mental health and substance use problems. Furthermore, general practitioners and health professionals need to consider the possibility that smokers may have a number of other problems that will decrease their chances of successfully giving up smoking.

1. INTRODUCTION

Tobacco is one of the most widely used psychoactive substances in the general population (Anthony, Warner, & Kessler, 1994; Australian Institute of Health and Welfare, 1999; Farrell et al., 1998; Warner, Kessler, Hughes, Anthony, & Nelson, 1995). In the most recently conducted National Drug Strategy Household Survey (1998), one in four persons aged 14 years and over (26.4%) reported use of tobacco within the past year, with two thirds (65.1%) reporting lifetime use (Australian Institute of Health and Welfare, 1999). One in seven persons in the general population indicated that tobacco was their drug of choice. However, public perceptions of tobacco use indicated that it was largely forgotten when considering substances that were problematic: only 4.2% nominated it a “problem” drug (Australian Institute of Health and Welfare, 1999).

Tobacco contains nicotine, which acts on nicotinic receptors in the brain (Benowitz, 1998a). Nicotinic receptor activation results in increased transmission of a number of neurotransmitters including acetylcholine, norepinephrine, dopamine, serotonin, glutamate and β -endorphin. It is thought that the behavioural rewards of nicotine, and perhaps the basis of nicotine dependence, is linked to the release of dopamine (Benowitz, 1998a). The dopaminergic system is thought to be the brain’s “reward” pathway, and has also been implicated in dependence upon alcohol, cocaine and opiates (Koob & LeMoal, 1997).

Research evidence is increasingly suggesting that the major mental disorders are characterised by disturbances in neurotransmitter function (Davidson, Abercrombie, Nitschke, & Putnam, 1999; Markou, Kosten, & Koob, 1998; Stahl, 1996). A number of neurotransmitter systems are thought to be affected in depression, including serotonin, norepinephrine, dopamine, and acetylcholine (Markou et al., 1998; Stahl, 1996). Anxiety disorders are also thought to be characterised by neurotransmitter dysfunction. Obsessive-compulsive disorder (OCD) is associated with serotonin and dopamine dysfunction (Stahl, 1996), while panic disorders are thought to be related to norepinephrine function (Stahl, 1996). Psychotic disorders have long been hypothesised to be related to excess dopamine transmission, particularly in the mesolimbic dopamine pathway (Stahl, 1996); this is the area that is thought to be the central area of activity of many of the drugs of dependence, including nicotine (Koob & LeMoal, 1997).

Clearly, on the basis of the neurophysiological characteristics of mental disorders and of the effects of psychoactive drugs, nicotine use is potentially relevant to mental health. It may hold implications for treatment approaches for both nicotine dependence, and for mental health problems.

Studies of clinical samples have revealed high rates of tobacco use among persons with depression (Hughes, Hatsukami, Mitchell, & Dahlgren, 1986), findings which have been replicated in US community surveys of young adults (Breslau, Kilbey, & Andreski, 1991; Kandel, Davies, Karus, & Yamaguchi, 1986) and adults (Anda et al., 1990). Clinical studies have also found that persons with anxiety disorders have high rates of tobacco use (Hughes et al., 1986; Pohl, Yeragani, Balon, Lycaki, & McBride, 1992). Research with clinical populations has also found that persons with psychotic illnesses, particularly schizophrenia, are highly likely to smoke (Glass, 1990; Goff, Henderson, & Amico, 1992; Hughes et al., 1986; Kendler et al., 1993; Masterson & O'Shea, 1984; O'Farrell, Connors, & Upper, 1983).

Tobacco use has been even more strongly associated in clinical settings with other substance use (Hays, Farabee, & Miller, 1998). It is more common among patients using greater amounts of alcohol and other drugs (Henningfield, Clayton, & Pollin, 1990), and among those with more problematic use of alcohol and other drugs (DiFranza & Guerrera, 1990; Hays et al., 1998; Henningfield et al., 1990). Research has also found that alcohol-dependent inpatients had more severe levels of nicotine dependence than controls (Marks, Hill, Pomerleau, Mudd, & Blow, 1997), while conversely, nicotine dependence was strongly associated with dependence upon alcohol, cannabis and other drugs in a community sample of young adults (Breslau et al., 1991).

EXPLANATIONS OF COMORBIDITY

There are a number of reasons why tobacco use and mental health problems might co-occur. First, it could be due to a causal relationship: this possibility has aroused considerable interest and debate. There are two ways in which such a relationship might exist. One is that nicotine use might arise as an effort to self-medicate symptoms of mental disorders such as depression. On a neurophysiological level, this explanation is plausible: nicotine increases dopamine and acetylcholine transmission, which are known to be reduced among depressed persons. Hence, nicotine could be used in an attempt to reduce mental health problems.

The other form of a causal relationship is that nicotine use might cause symptoms of mental distress. It has been hypothesised that chronic substance use may lead to changes in the “set point” of the brain, with changes in the neurobiology occurring (Koob & LeMoal, 1997). This would mean that after continued use, nicotine alters the brain’s “resting” state, with the result that symptoms of depression or negative affect result in the absence of nicotine. This is consistent with reports of persistent symptoms of depression, that extend beyond the 2-3 day period of withdrawal from nicotine (Breslau, Kilbey, & Andreski, 1992; Glassman, 1993).

Before examining the nature of any direct relationship between two disorders, the first step is to rule out the possibility that the association is based on common risk factors (or perhaps on indirect effects of one upon the other). To this end, it is necessary to consider several factors have previously been associated with tobacco use and mental health problems. These will be outlined below.

First, tobacco use is related to gender, with males more likely to use tobacco than females (Anthony & Helzer, 1991; Anthony et al., 1994; Bijl, Ravelli, & van Zessen, 1998; Greenfield & O’Leary, 1999; Helzer, Burnam, & McEvoy, 1991; Kandel, Chen, Warner, Kessler, & Grant, 1997; Kessler et al., 1997; Whitlock et al., 1997). In contrast, females are more likely to report anxiety and affective disorders (Blazer, Hughes, George, Swartz, & Boyer, 1991; Eaton, Dryman, & Weissman, 1991; Weissman, Livingston Bruce, Leaf, Floio, & Holzer, 1991).

Second, age is also a strong predictor of tobacco use, which is much more prevalent among younger adults (Anthony & Helzer, 1991; Anthony et al., 1994; Bijl et al., 1998; Helzer et al., 1991; Kandel et al., 1997; Kessler et al., 1997). There is evidence to suggest that depression and anxiety may also be more common among younger people (Henderson et al., 1998).

Educational attainment has been negatively correlated with tobacco use (Kandel et al., 1997; Robins & Regier, 1991). Tobacco use is also more common among those who are unemployed (Giovino,

Henningfield, Tomar, Escobedo, & Slade, 1995; Kandel et al., 1997). Socioeconomic status (SES) has also been found to correlate with drug use, with persons from lower SES backgrounds more likely to be tobacco users than those from higher SES backgrounds (Whitlock et al., 1997).

Temperament may also be associated with tobacco use, particularly the trait of neuroticism: persons scoring high on measures of neuroticism have been characterised as more anxious, worrying, depressed and moody (Eysenck & Eysenck, 1991). While early research studies provided conflicting evidence on the relationship between neuroticism and smoking (Eysenck, 1963; Golding, Harpur, & Brent-Smith, 1983), more recent research has found that smokers have higher than average neuroticism scores (Breslau, Kilbey, & Andreski, 1993; Kendler et al., 1999; Sieber & Angst, 1990).

Finally, persons who use tobacco are more likely than non-users to use other drugs (Hays, Farabee, & Miller, 1998; Henningfield, Clayton, & Pollin, 1990)). Since the relationship between tobacco use and mental health could be due to the effects of other drug use on mental health, this factor needs to be taken into account.

Although clinical data provides information about the patterns of tobacco use and mental health among persons coming to the attention of treatment services, it is prone to selection biases. This means that while associations may be found between mental health and tobacco use in clinical populations, this relationship may not be representative of the general population.

Epidemiological research into the associations between tobacco use and mental health has been conducted with samples of young adults in the US (Breslau, Kilbey, & Andreski, 1991; Breslau et al., 1993), and with community surveys (Anda et al., 1990). However, there has been less investigation of the association between tobacco use and a range of mental health indicators including disability and psychological distress. Furthermore, there has been little examination of this relationship after controlling for possibly confounding factors. Finally, there has been no in-depth investigation of the relationships between tobacco use, drug use, and mental health in the Australian population. All of these factors need to be addressed in order to determine the public health importance of tobacco use and mental health, and to consider the ramifications for treatment provision.

AIMS

The current report examines tobacco use in the Australian population, using the recently conducted (1997) National Survey of Mental Health and Well-Being (NSMHWB). It looks specifically at the characteristics of those who use tobacco, and the relationships that may exist between tobacco use and indicators of mental health and well-being. Although a recent paper used data from the NSMHWB to examine the relationship between smoking, anxiety and affective disorders, it was limited to discussing gender and age-related patterns (Jorm, 1999).

The NSMHWB provides nationally representative data about the mental and physical health of Australian persons aged 18 years and over. Unlike previous epidemiological surveys, the NSMHWB included measures of role functioning related to physical and emotional health, as well as measures of disability and psychological distress. Hence, the NSMHWB not only provides an opportunity to examine the associations between involvement with substance use and mental disorders, but also the association between substance use and other indicators of psychological well-being. This allows examination of the following questions:

1. What are the patterns of tobacco use in the Australian population?
2. What are the differences between the characteristics of tobacco users and non-users?
3. Is there an association between tobacco use and the following indices of mental well-being:
 - a. alcohol, cannabis and other drug use disorders;
 - b. affective disorders and anxiety disorders;
 - c. screening positively for psychosis;
 - d. life satisfaction and psychological distress;
 - e. role functioning due to emotional well-being?
4. Do these associations remain after controlling for demographic variables?
5. Do these associations remain after controlling for demographic variables and other drug use?

2. METHOD

The NSMHWB sample was a stratified multistage probability sample of 10641 persons aged 18 years and older in the Australian population, carried out by the Australian Bureau of Statistics (ABS) in 1997. The overall response rate was 78%. The NSMHWB sampling design and its implementation have been described previously (Australian Bureau of Statistics, 1998).

All persons were asked whether they currently used tobacco. If they were current users, they were asked if their use was regular (at least daily). Respondents were assessed for alcohol use disorders if they had consumed at least 12 standard drinks in the last 12 months. A standard drink was defined as 10g of alcohol. Persons were asked if they had used cannabis, stimulants, sedative or opiates more than five times in the past 12 months; if so, they were assessed for a use disorder.

Questioning was restricted to symptoms in the last 12 months to minimise the uncertainty about recall of symptoms over longer periods. Mental disorders were assessed by a modified version of the CIDI (World Health Organisation, 1993) which yielded diagnoses of the following DSM-IV disorders:

1. Substance use disorders: alcohol abuse and dependence, as well as abuse and dependence on four drug classes: opiates, cannabis, stimulants, and sedatives;
2. Affective disorders: major depressive disorder, dysthymia, bipolar I disorder, bipolar II disorder; and
3. Anxiety disorders: panic disorder, agoraphobia, social phobia, generalised anxiety disorder, obsessive-compulsive disorder, and post-traumatic stress disorder.

A short scale was also included that screened for the likelihood of psychosis (the Psychosis Screener (PS)). Analyses suggest that this screener is moderately effective for screening persons who satisfy criteria for schizophrenia or schizoaffective disorder¹.

Several other measures of psychological well-being will be involved in the analyses:

1. Kessler's Psychological Distress scale, which assesses symptoms of nervousness, restlessness and depressed affect (Kessler, 1996).
2. The General Health Questionnaire (GHQ), which was designed as a screening instrument to detect likely non-psychotic psychiatric "cases" in general health care settings (Goldberg & Williams, 1988). In the present analyses, both the categorical (screening positive as a likely case) and continuous methods of scoring the GHQ will be used.
3. As an indicator of general life satisfaction, participants were asked the following question: "How do you feel about your life as a whole, taking into account what has happened in the last year and what you expect to happen in the future?" Participants rated their view on a scale from 1 ("Delighted") to 7 ("Terrible") – referred to as the "Delighted-Terrible" scale.
4. The Short Form 12 (SF-12) was also included, which assesses possible limitations in both physical and mental health: the mental component summary (MCS) examines role limitations due to emotional and mental health problems (Ware, Kosinski, & Keller, 1996).

DATA ANALYSIS

A dichotomous variable was created, which categorised persons as current smokers or current non-smokers. Although it was possible to divide current smokers into "daily" and "non-daily" smokers, this distinction is not presented in the report, as analyses of the two groups indicated there were no significant differences between the groups. Similarly, although it was possible to divide current non-smokers into "never" and "former" smokers, analyses indicated no differences between these two groups.

All analyses were carried out using SPSS for Windows 6.1.4. All prevalence estimates were made using weighted data, which ensured that the estimates conformed to independent population estimates by State, part of State, age and sex.

¹ Unpublished analyses; details can be obtained from the authors of this report.

COVARIATES

In order to adjust for possibly confounding factors, several covariates were examined. The univariate relationships between the use of tobacco and the covariates were explored using Pearson's chi square. The univariates were included in multivariate analyses of the relationship between tobacco involvement and mental health outcomes. These analyses examined the possibility that the relationships with other variables explained the associations between mental health and tobacco use. The covariates were coded as follows:

- Gender was coded 0 for females, and 1 for males.
- Age was coded 0 for 18-24 years, 1 for 25-34 years, and so on until coded 6 for 75 years and over.
- Education was coded: "less than secondary schooling completed" (0), "secondary schooling completed" (1), and "post-secondary schooling completed" (2).
- Unemployment status was coded "employed or not in the labour force" (0) and "unemployed" (1).
- A measure of socioeconomic status (SES) was included, with scores ranging from the lowest decile (score of 1) to the top two deciles (score of 9).
- Score on the Neuroticism (N) scale of Eysenck's Personality Questionnaire (EPQ).
- Alcohol use disorders (either abuse or dependence) in the past 12 months were coded 1.
- Cannabis use more than 5 times in the past 12 months was coded 1.
- Other drug use was coded on the basis of the number of drug types (sedatives, stimulants and opiates) used more than 5 times in the past in the past 12 months. Scores on this variables ranged from "no use of these drug types" (0) to "use of all three drug types" (3).

Adjusted means for continuous outcome variables were calculated using MANOVA. For dichotomous outcome variables, a variable was computed for each level of involvement with each of the drug types, which reflected the equation produced by the logistic regression. The equation was as follows:

$$X_a \text{ adjusted} = 1 / [1 + (\text{Exp}(a \cdot \beta_x - \text{INT}))]$$

X = tobacco use

a = value of the tobacco use variable

β = beta regression coefficient for variable

$\text{INT} = \beta_0 + \beta_1 \cdot \text{age} + \dots + \beta_j \cdot \text{weight}$

3. RESULTS

Table 1 shows the demographic characteristics of persons classified by smoking status. One in four persons (24.9%) reported they were current tobacco users. Males (26.9%) were more likely to be smokers than females (23%; $\chi^2(1df) = 17.0, p < .00004$).

Table 1: Demographic characteristics of tobacco smokers

	No current tobacco use % (n)	Current smoker %
Prevalence (n)	75.1 (7874)	24.9 (2767)
Female	77.0	23.0
Male	73.1	26.9
Age group		
18-24	65.9	34.1
25-34	67.3	32.7
35-44	72.0	28.0
45-54	77.7	22.3
55-64	83.3	16.7
65-74	86.3	13.7
75+	92.0	8.0
Education		
Less than secondary	70.4	29.6
Secondary only	74.7	25.3
Post-secondary	78.3	21.7
SES (M (SD))	6.2 (3.0)	5.5 (3.1)
Unemployed	52.4	47.6
Employed/not in labour force	76.1	23.9
EPQ score (M)	2.4	3.1
Sedative, stimulant and opiate use past 12 months		
None	75.7	24.3
1 drug type used	60.8	39.2
2 drug types used	45.0	55.0
3 drug types used	16.1	83.9

Tobacco use was strongly related to age ($\chi^2(6df) = 404.5, p < .00001$). Smoking was most common among the youngest age group, with more than one in three persons aged 18-24 years (34.1%) reporting current tobacco use. This proportion decreased with increasing age, such that only 8% of persons over 75 years reported current use.

Those with less formal education were more likely to be smokers than more educated persons ($\chi^2(2df) = 55.5$, $p < .00001$), as were those who were unemployed ($\chi^2(1df) = 131.6$, $p < .00001$). Tobacco users also had a lower socio-economic background ($\chi^2(8df) = 110.2$, $p < .00001$).

There was a significant association between tobacco use and scores on the EPQ Neuroticism scale. Tobacco users had higher average scores than non-users ($M = 3.1$ for smokers, 2.4 for non-smokers; $\chi^2(12df) = 157.7$, $p < .00001$), indicating they reported indicate higher trait levels of anxiety, moodiness and irritability.

Finally, the use of other drug types was strongly related to tobacco use, with tobacco users significantly more likely to use other drugs ($\chi^2(3df) = 75.2$, $p < .00001$). Three quarters (75.7%) of those who had not used sedatives, stimulants or opiates more than 5 times in the past 12 months were non-smokers; in contrast, over four fifths (83.9%) of those who had used sedatives *and* stimulants *and* opiates in the past 12 months were current smokers.

SUBSTANCE USE DISORDERS

Figure 1 shows the relationship between tobacco use and the prevalence of DSM-IV drug and alcohol use disorders (see also Appendix A). Those who were current tobacco users were almost 4 times more likely (OR 3.95, 95%CI 3.35, 4.66) to have an alcohol use disorder, with approximately 13% of users compared to 4% of non-users having such a disorder. Current smokers were also more likely to meet criteria for a sedative, stimulant, or opiate use disorder (OR 4.69; 95%CI 3.11, 7.09). The association with cannabis use was even stronger, with smokers 7.64 times more likely (95%CI 5.70, 10.23) to have a cannabis use disorder.

The strength of the association between tobacco use and all substance use disorders was reduced when controlling for demographic variables and other drug use (Appendix B). Nevertheless, a significant relationship remained between all forms of substance use disorders. Current tobacco users were almost twice as likely to have a sedative, stimulant, or opiate use disorder (OR 1.94, 95%CI 1.21, 3.10), more than twice as likely to have an alcohol use disorder (OR 2.25, 95%CI 1.88, 2.68), and 3.56 times more likely to have a cannabis use disorder (95%CI 2.60, 4.87; see Figure 1, Appendix B).

Figure 1: Unadjusted prevalence (%) of DSM-IV alcohol and drug use disorders by tobacco use

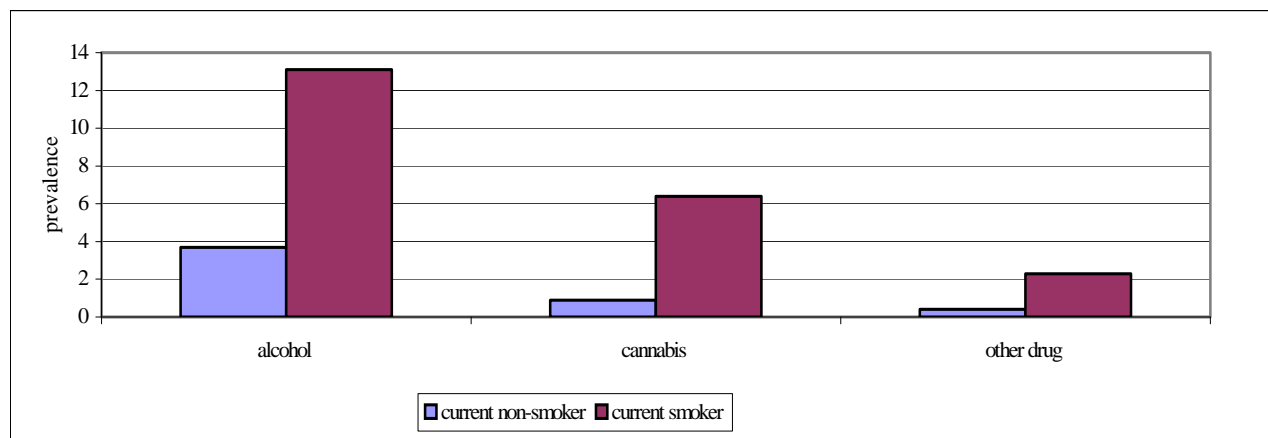
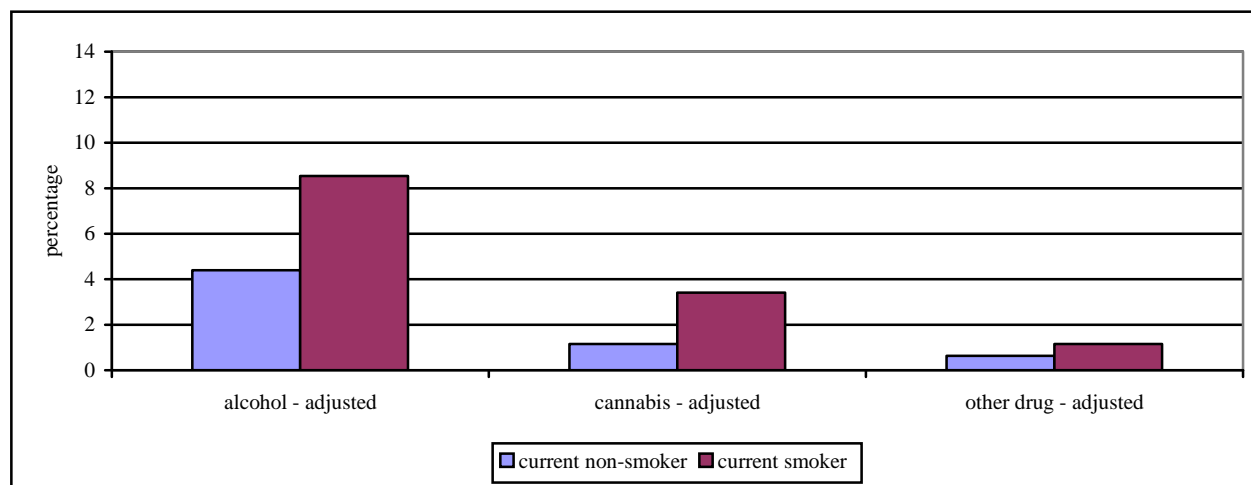


Figure 2: Prevalence (%) of DSM-IV alcohol and drug use disorders by tobacco use after adjusting for covariates



N.B. Adjusted estimates produced after controlling for age, gender, SES, education level attained, employment status, EPQ score, other drug use and data weights

AFFECTIVE AND ANXIETY DISORDERS

A strong univariate relationship also existed between tobacco use and anxiety and affective disorders (Figure 2, Appendix A). Around one in 10 smokers had an affective disorder (10.9%), with a similar proportion having an anxiety disorder (9.3%). In contrast, around one in 20 non-smokers had an affective (5.4%) or an anxiety disorder (4.5%). This difference remained significant after adjusting for demographic and other drug use variables, with the odds of an affective disorder 1.4 times greater among smokers compared to non-smokers, and an anxiety disorder 1.6 times more likely (Appendix A, B).

Figure 3: Unadjusted prevalence (%) of DSM-IV affective and anxiety disorders by tobacco use

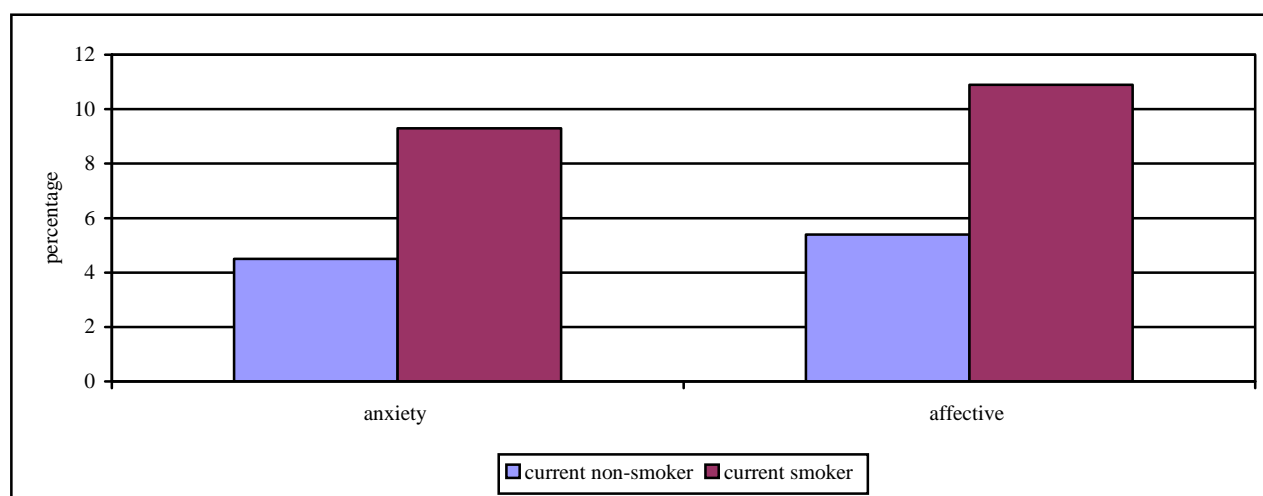
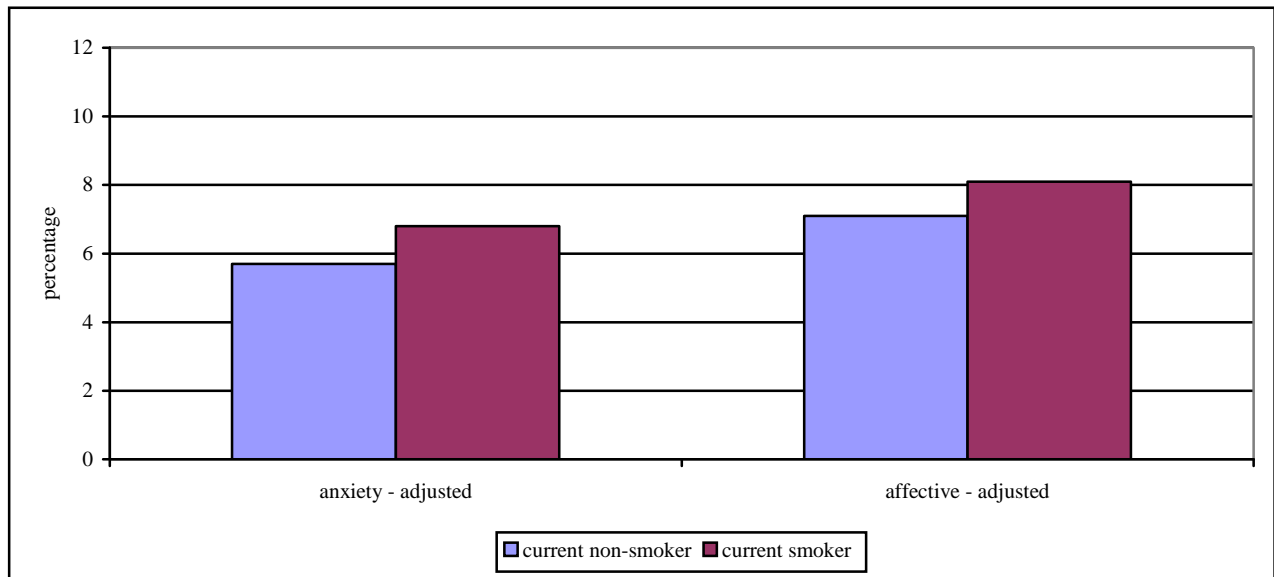


Figure 4: Prevalence (%) of DSM-IV affective and anxiety disorders by tobacco use after adjusting for covariates

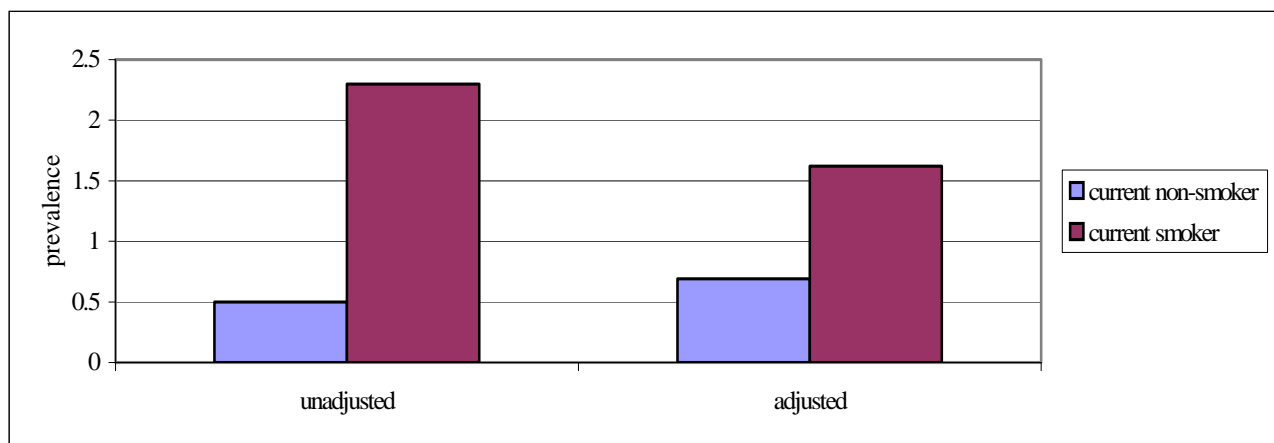


N.B. Adjusted figures produced after controlling for age, gender, SES, education level attained, employment status, EPQ score, other drug use and data weights

PSYCHOSIS

The relationship between tobacco use and possible psychosis was also examined (Appendix A). There was a significant univariate association between tobacco smoking and screening positively for psychosis. Around 1 in 200 non-smokers (0.5%) screened positively for psychosis, compared to 1 in 43 smokers (2.3%; Appendix A). This association remained significant when controlling for both demographic factors and other drug use, with smokers still 2.47 times more likely than non-smokers (95%CI 1.65, 3.75) to screen positively for psychosis (Appendix A, B).

Figure 5: Prevalence (%) of persons screening positively for psychosis by tobacco use

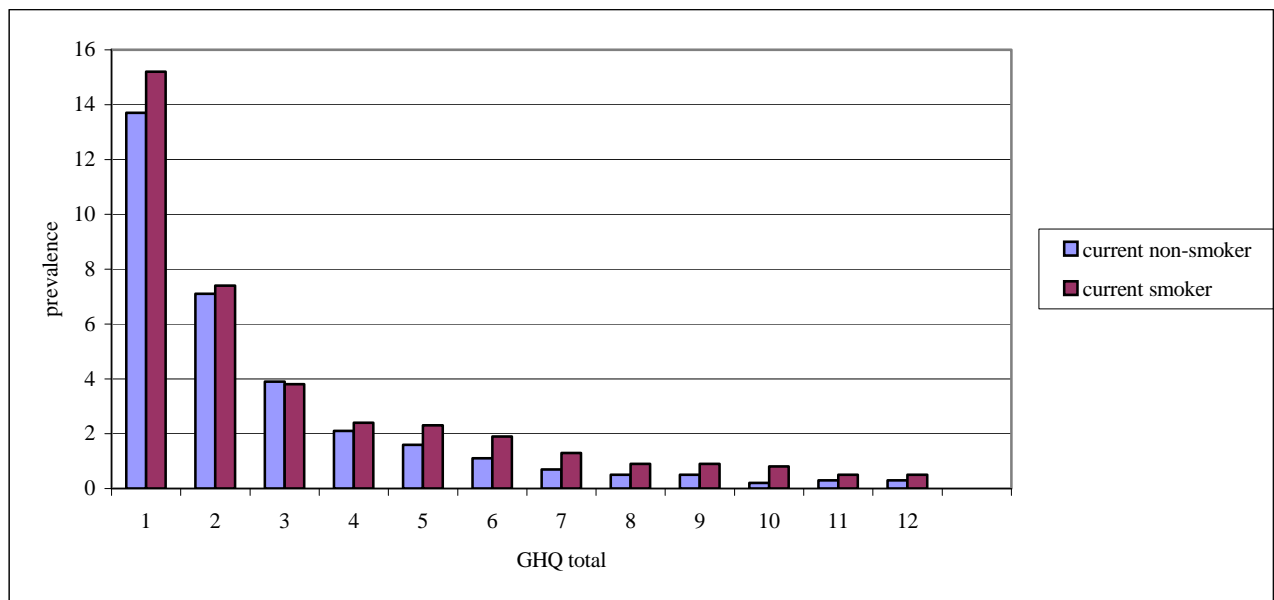


N.B. Adjusted figures produced after controlling for age, gender, SES, education level attained, employment

status, EPQ score, other drug use and data weights
PSYCHOLOGICAL DISTRESS AND DISABILITY

Approximately 68% of non-smokers and 61% of smokers scored zero on the GHQ; a higher score indicates poorer functioning. Figure 3 shows the distribution of non-zero scores on the GHQ by smoking status. GHQ scores were significantly higher among current smokers ($M = 1.2$) than current non-smokers ($M = 0.8$), indicating that smokers reported more symptoms of distress and poorer functioning in everyday life (Figure 3, Appendix A). This translated into around 16% of smokers and 11% of non-smokers exceeding the cut-off point for a possible “psychiatric case”. This meant that smokers were 1.5 times more likely to screen positively on the GHQ (95%CI 1.31, 1.67). Although the difference in the proportion screening positively was no longer significant after controlling for demographics and drug use, smokers had significantly higher average GHQ scores than non-smokers (Appendix A, B).

Figure 6: Distribution of scores on the General Health Questionnaire (GHQ) by tobacco use



Similar patterns were observed for other measures of psychological distress and disability (Figure 4, Appendix A). Smokers reported significantly greater role limitations due to emotional problems, and problems with psychological functioning (as assessed by the SF-12; Appendix A). This relationship was substantially attenuated after controlling for demographics and other drug use, but remained significant (Figure 4, Appendix A, B).

Smokers also reported higher psychological distress as measured by Kessler’s psychological distress scale (Figure 4, Appendix A). This association remained significant after controlling for demographics and for other drug use, with tobacco use associated with significantly higher levels of psychological distress (Appendix A, B).

Figure 7: Mean scores on the SF-12 Mental summary score (MCS-12) and Kessler's psychological distress scale by tobacco use

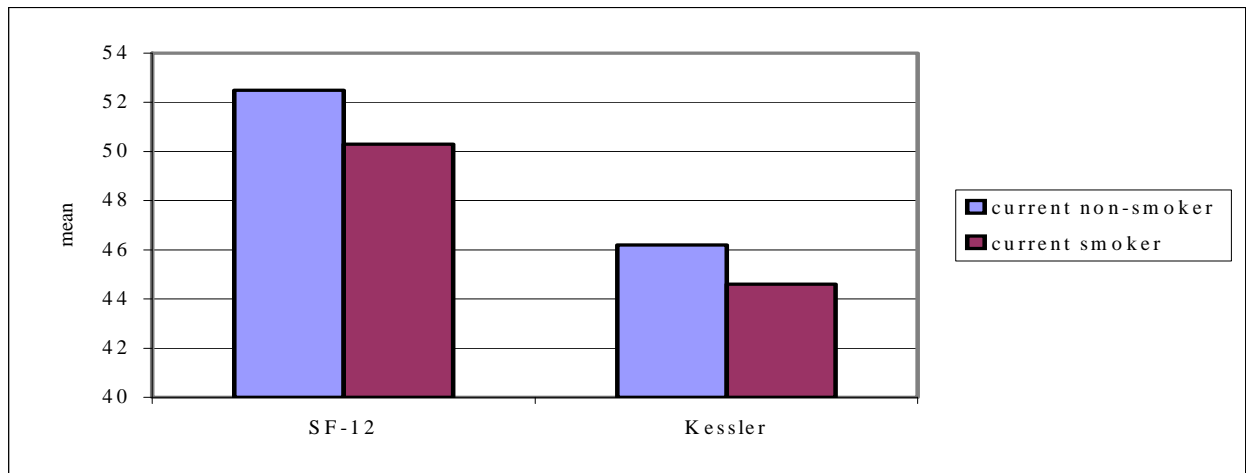
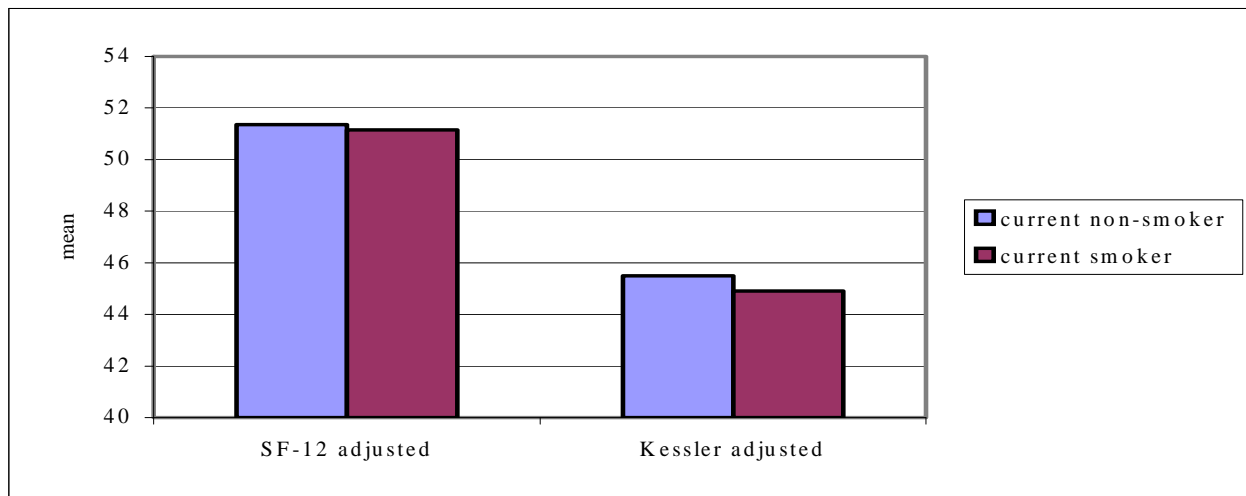


Figure 8: Mean scores on the SF-12 Mental summary score (MCS-12) and Kessler's psychological distress scale by tobacco use after adjusting for covariates



N.B. Adjusted figures produced after controlling for age, gender, SES, education level attained, employment status, EPQ score, other drug use and data weights

Satisfaction with “life as a whole” was significantly lower among smokers ($M = 3.2$) than it was among non-smokers ($M = 2.7$). This association remained after controlling for confounding variables (Appendix A, B).

4.0 DISCUSSION

TOBACCO USE AND DEMOGRAPHIC CHARACTERISTICS

Among a representative sample of Australian adults, tobacco use was related to a number of demographic characteristics. Increased involvement with tobacco use was more likely among males, and strongly related to age, with use far more common among younger persons. Those with less education and those from a lower socioeconomic background were also more likely to smoke. These patterns are consistent with the patterns found in epidemiological research conducted in other countries (Kandel et al., 1997; Warner et al., 1995; Whitlock et al., 1997).

The strong socioeconomic relationship may reflect a differential effectiveness of health education campaigns, with those who are better educated more likely to quit smoking, leading to a strong inverse relationship between social class and cigarette smoking. Greater attention to public health campaigns targeted at these socioeconomic levels could serve to decrease this differential.

TOBACCO USE AND NEUROTICISM

Scores on the Neuroticism scale of the EPQ were strongly related to involvement with tobacco use, with smokers reporting higher emotional lability and negative affect. This finding lends support to other recent findings that neuroticism is a significant correlate of tobacco use (Breslau et al., 1993; Gilbert & Gilbert, 1995; Kendler et al., 1999; Sieber & Angst, 1990). The stronger relationship between neuroticism and tobacco use in more recent times suggests that with the decline in rates of tobacco use in Australia, more neurotic persons are more likely to begin smoking, and less likely to quit once they have started (Gilbert & Gilbert, 1995).

TOBACCO USE AND OTHER DRUG USE

Tobacco use was strongly related to the use of multiple drug types. The majority of persons who had not used sedatives, stimulants or opiates were also non-smokers. In contrast, those who had used all three of these drugs were most likely to be smokers.

Current smoking was also strongly related to alcohol, cannabis and other drug use disorders. These findings support those of a study of young adults from a health care organisation in the US (Breslau et al., 1991), in which smokers were significantly more likely than non-smokers to satisfy criteria for cannabis, alcohol, and other drug use disorders. The findings are also consistent with twin studies examining tobacco withdrawal and alcohol dependence (Madden et al., 1997), and clinical evidence indicating that persons with alcohol and drug use disorders are likely to be smokers (DiFranza & Guerreria, 1990; Hays et al., 1998; Henningfield et al., 1990).

For all drug types examined, this relationship was not entirely due to the effects of covariates examined here. This suggests that the relationship between smoking and other drug abuse is not simply due to shared demographic characteristics of users, neuroticism, or other drug use.

The issue of why the use of different drug types is correlated has been the subject of considerable debate. One view, the “gateway hypothesis”, characterises what has been termed the “developmental sequence” of drug use (Kandel & Faust, 1975; Kandel, Davies, Karus, & Yamaguchi, 1986; Kandel, Yamaguchi, & Chen, 1992). This proposes that substance use progresses through stages, with progression to a higher stage made more likely by use of a drug at an earlier stage, and of which the earliest stage tends to be the use of tobacco and alcohol. The use of cannabis and other so-called “harder” drugs occurs later on, and is more likely to occur following use of tobacco or alcohol.

This may describe the pattern in which drug use occurs, however it does not preclude the possibility that other factors explain the pattern. Longitudinal research suggests that much of the association between the use of different drug types is due risk factors which may be thought to constitute a “pathway” in which all types of drug use are made more likely. For example, persons with more risk factors, such as poor parental relationships and low self-esteem, were more likely to use all drug types (Lynskey, Fergusson, & Horwood, 1998; Newcomb, Maddahian, & Bentler, 1986). Other research has found that individuals with early drug use are also likely to subsequently associate with delinquent peers and move out of home, factors that increase the likelihood of poor outcomes later on (Fergusson & Horwood, 1997).

The present analyses have taken into account a range of factors that have been found to be characteristic of this “pathway”, including unemployment, poor educational achievement and socioeconomic status. While accounting for these factors reduced the size of the relationship, the association between smoking and other drug use disorders remained strong. Nevertheless, it must be noted that there are many possible covariates that have not been included in the present analyses, including genetic factors and other factors such as family characteristics.

It is possible that genetic vulnerabilities may play a role in increasing the likelihood of problematic substance use. Genetic factors have been implicated as increasing the likelihood of alcohol dependence (Kendler, Neale, Heath, Kessler, & Eaves, 1994; Kendler, Prescott, Neale, & Pedersen, 1997), cannabis dependence (Kendler & Prescott, 1998a), nicotine dependence (Kendler et al., 1999) and cocaine dependence (Kendler & Prescott, 1998b). Common genetic vulnerabilities have been found to predict both nicotine and alcohol dependence among male twins (True et al., 1999); it is possible that vulnerabilities may be similar across other drug types, given that different drugs act upon the same neurotransmitters. For example, there is evidence suggesting that nicotine dependent persons have altered responsiveness of the endogenous opioid system, suggesting that nicotine may act upon the same receptors that are affected by opiates and alcohol (Krishnan-Sarin, Rosen, & O'Malley, 1999).

TOBACCO USE, AFFECTIVE DISORDERS, AND SYMPTOMS OF DEPRESSION

There was a significant univariate difference between smokers and non-smokers in the prevalence of affective disorders. The increased rate of affective disorders among smokers remained when controlling for covariates including demographic variables, neuroticism, and other drug use. Similarly, measures of psychological distress (Kessler's Psychological distress scale, the SF-12, and the GHQ) that include symptoms of depression were also significantly related to smoking status, with smokers reporting higher levels of distress. These findings are consistent with previous research in other populations showing an association between tobacco use and depression (Anda et al., 1990; Glassman,

Helzer, & Covey, 1990; Glassman et al., 1988; Kandel & Davies, 1986; Kandel et al., 1986; Kendler et al., 1993; Patton et al., 1998; Pomerleau, 1997).

The reasons for the connections between tobacco use and depression have been the focus of considerable debate (Gilbert & Gilbert, 1995; Glass, 1990; Glassman, 1993; Pomerleau, 1997). There is evidence to suggest that common genetic factors increase the risk of both tobacco smoking and major depression (Kendler et al., 1993). This finding is consistent with research that has shown that each of tobacco use and depression are both predictive of the other at a later point in time. Specifically, depressive symptoms predict smoking at a later age (Breslau et al., 1993; Kandel & Davies, 1986; Kendler et al., 1999), and a history of nicotine dependence predicts development of major depression during a follow-up period (Breslau et al., 1993).

There may also be an interaction between smoking and depression, with the presence of either smoking or depression leading to an increased likelihood of the other. For example, continued exposure to nicotine may cause changes in neurotransmitter function leading to an increased likelihood of depressive symptoms (such an effect has been found in animal studies (Kirch, Gerhardt, & Shelton, 1987)). On the other hand, the increased prevalence of smoking among persons with depression may also arise because depressed smokers are less likely to quit successfully. Both epidemiological and clinical research has shown that persons with depressive symptoms have lower rates of quitting (Anda et al., 1990; Glassman et al., 1990; Glassman et al., 1988).

The nature of the association between tobacco use and depression cannot be determined from the present analyses. However, the finding that tobacco use is associated with both affective disorders and depressive symptoms, independent of a range of other factors associated with the presence of each, has important clinical and public health implications.

Depression decreases the likelihood that attempts to quit smoking will be successful (Anda et al., 1990); interventions that improve the success of attempts to quit would be of particular use among this group. Nicotine acts upon a range of loci in the brain to affect the availability of several neurotransmitter types, including dopamine, serotonin and norepinephrine (Benowitz, 1998a; Pomerleau, 1997). Persons with major depression have reduced or impaired dopamine, serotonin and norepinephrine function, and research has shown that EEG abnormalities found in depression were alleviated by the administration of nicotine (Gilbert, Gehlbach, Estes, Rabinovich, & Detwiler, 1994a; Gilbert, Melissa, Welser, & Estes, 1994b). Hence, nicotine may be thought to have effects of an antidepressant nature. This suggests that antidepressant medication could improve the rates of cessation among depressed smokers.

A study of the effectiveness of nortriptyline, a tricyclic antidepressant with adrenergic activity, was carried out comparing its effectiveness for persons with and without a history of major depression [Hall, 1998 #424]. Persons given nortriptyline were over twice as likely to achieve continuous abstinence than those given a placebo (abstinence rates of 24% and 12%, respectively, at 64 weeks). Persons with a history of major depression were no more likely than those without such a history to achieve abstinence when given the treatment [Hall, 1998 #424]. However, they were also no *less* likely to quit; given the fact that persons with depression have been estimated to be 40% less likely to quit than non-depressed smokers (Anda et al., 1990), nortriptyline may have served to increase the quitting rate among those with a history of depression to a level similar to persons without depression.

Antidepressant medication may also aid quit attempts for smokers in general. Depressed mood is a commonly symptom of withdrawal from nicotine (Madden et al., 1997). Research using nortriptyline

found that non-depressed smokers were aided by this antidepressant [Hall, 1998 #424]. Another antidepressant, bupropion, an atypical antidepressant with dopaminergic and adrenergic actions, has been approved by the US for use as a smoking cessation aid (Hughes, Stead, & Lancaster, 1999). Trials suggest that the use of bupropion may increase cessation rates two-fold compared to placebos (Hurt et al., 1997; Jorenby et al., 1999).

Psychosocial interventions may also be beneficial for depressed persons attempting to quit smoking. A recent study found that cognitive behavioural therapy that focussed on mood management were of benefit, with smokers with a history of depression benefiting significantly more from such therapy than smokers without such a history [Hall, 1998 #424]. Smokers with depression may particularly benefit from these more intensive interventions.

The use of nicotine replacement therapies may also aid attempts to quit. There are a range of products available, including nicotine patches, nicotine gum, nasal sprays, and inhalers. These have different speeds of onset, peak plasma levels of nicotine, and duration of effects, with the slowest acting being nicotine patches, and the most immediate nasal sprays (Stitzer & DeWit, 1998). Studies of the effectiveness of these products suggest that replacement therapies increase the odds of successful cessation by 70%, with rates of 19% abstinent at 1 years compared to 11% of controls (Silagy, Mant, Fowler, & Lodge, 1994). Nasal sprays and inhalers were more effective than nicotine patches or gum. Research has suggested that the combined use of nicotine patches and bupropion results in non-significant increases in cessation rates compared to the use of bupropion alone (Jorenby et al., 1999). The evidence suggests that a range of interventions may be of particular use for depressed persons.

Finally, nicotine may be useful as a treatment for depression. As discussed above, nicotine appears to have antidepressant effects on the brain (Benowitz, 1998b). There is evidence that the administration of nicotine reverses characteristic EEG patterns seen in depressed persons (Gilbert, Gehlbach, Estes, Rabinovich, & Detwiler, 1994a; Gilbert, Melissa, Welser, & Estes, 1994b). Research examining the efficacy and feasibility of such treatments would be of use.

TOBACCO USE, ANXIETY DISORDERS, AND SYMPTOMS OF ANXIETY

Smokers also had higher rates of anxiety disorders, both in univariate analyses, and after controlling for demographics and other drug use. This is consistent with previous research (Breslau et al., 1991; Hughes et al., 1986; Patton et al., 1998; Pohl et al., 1992). Measures of psychological distress in which symptoms of anxiety were included (the SF-12, the GHQ and Kessler's Psychological distress scale) were also associated with smoking, with smokers reporting higher levels of distress.

In comparison with the research on smoking and depression, considerably less research has been carried out on the nature of the relationship between tobacco use and anxiety. It is possible that anxious persons use tobacco as a means of self-medication of anxiety symptoms, or to avoid increased anxiety symptoms upon nicotine withdrawal (Gilbert & Gilbert, 1995). Persons with anxiety may therefore find it more difficult to give up smoking (Gilbert & Gilbert, 1995).

The use of anxiolytics could be considered one way to increase the ability of smokers with anxiety disorders to quit successfully. Studies have examined a range of anxiolytics, one of which was buspirone, a non-benzodiazepine anxiolytic that affects serotonin neurotransmissions. Short-term

trials provided inconsistent results (Hughes et al., 1999), while longer term follow-up periods (at least 6 months) found no beneficial effect upon cessation rates compared to placebos (Cinciripini et al., 1995; Schneider et al., 1996). Other anxiolytics have been examined, including beta-blockers, diazepam and ondansetron; again, however, the findings were not indicative of an increased rate of cessation (see (Hughes et al., 1999). A recent review of the evidence concluded that the use of anxiolytics to aid smoking cessation was not supported by existing evidence (Hughes et al., 1999).

There does not appear to be much research examining alternative therapies for smoking cessation among this population. Given that among Australian adults the relationship between tobacco use and anxiety disorders remained as least as strong as that with affective disorders, two important points need to be noted. First, health care professionals involved in assisting persons to stop smoking need to be aware of the possibility that smokers may have anxiety problems, a factor that could reduce the success of any quit attempts. This is of particular importance for general practitioners, who may come into contact with the majority of persons wishing to quit smoking. Second, there appears to be an absence of effective strategies for improving cessation rates among this population. Further research in this area could be of considerable merit. Research examining the effectiveness of antidepressant medication for persons with anxiety disorders who wish to quit smoking would be of considerable benefit. Furthermore, an investigation of the effectiveness of cognitive behavioural therapy for smokers with anxiety problems would be of use.

TOBACCO USE AND PSYCHOSIS

There was a significant relationship in the Australian population between tobacco use and the likelihood of screening positively for psychosis. This finding is in support of the consistent finding in clinical research of high rates of tobacco use among persons with psychotic illnesses, particularly schizophrenia (Dalack, Healy, & Meador-Woodruff, 1998; Diwan, Castine, Pomerleau, Meador-Woodruff, & Dalack, 1998; Hughes, Hatsukami, Mitchell, & Dahlgren, 1986). It is also consistent with recent research showing that persons with psychotic illnesses in the UK general population have an extremely high prevalence of tobacco use (Farrell et al., 1998).

Some have reasoned that smoking may be used as a means of coping with the side effects of antipsychotic medication (Gilbert & Gilbert, 1995; Glynn & Sussman, 1990; Goff, Henderson, & Amico, 1992). However, there is some suggestion that self-medication of schizophrenic symptoms may play a role, because of tobacco's ability to reduce positive symptoms such as hallucinations and delusions (Gilbert & Gilbert, 1995) and negative symptoms such as blunted affect, apathy and anhedonia (Gilbert & Gilbert, 1995; McEvoy & Brown, 1999). In support of this hypothesis, recent research suggests that the nicotinic receptors in the brain are involved in the sensorimotor gating deficits observed in persons with schizophrenia, and that the administration of nicotine reduces these deficits (Griffith et al., 1998). Finally, persons with schizophrenia may be more likely to use tobacco due to lower concern about the health effects of tobacco use; they may also tend to associate with persons who are more antisocial and from lower socioeconomic backgrounds, and who are more likely to smoke (Gilbert & Gilbert, 1995).

The significantly higher rate of smoking among persons with psychosis means they are at greater risk of tobacco-related diseases such as lung cancer, particularly some previous research suggests they smoke more heavily and use higher tar tobacco (Masterson & O'Shea, 1984), factors which would increase the harms associated with smoking. Nicotine maintenance may be one way in which these

harms may be reduced among this population, using nicotine patches or gum. Interventions aimed at abstinence may also be of use among this group. Unfortunately, there is no research that has examined the adequacy of such treatments for this group; future research might evaluate the feasibility of such an intervention.

CONCLUSIONS

In an Australian population sample, tobacco smoking was strongly related to a number of demographic characteristics. In particular, smoking was more common among younger persons, those with a lower socioeconomic status, who had completed less education, and who were unemployed. Smoking was also more common among those with higher levels of neuroticism. Finally, the use of sedatives, stimulants and opiates was far more likely among those who were tobacco users; and tobacco users were also more likely to report problematic use of other substances including alcohol, cannabis and other drug types.

Although controlling for the above factors reduced the strength of the association between mental health outcomes and smoking, it did not appear to explain the relationship between tobacco use and mental health. The relationship between tobacco use and the rate of anxiety and affective disorders remained even after accounting for these factors. The presence of psychotic symptoms was also strongly associated with tobacco use. Finally, scores on measures of psychological distress, depression and anxiety remained greater among tobacco users.

There are a number of implications of these findings. Public health strategies may be of use to address the marked relationship between tobacco use and socioeconomic status. The significantly higher rates of smoking among persons who come from less educated, lower socioeconomic backgrounds, and those who are unemployed, suggests that previous public health campaigns may not have successfully targeted this demographic group.

The relationships found between tobacco use and anxiety and depression highlight a continued need for effective treatments for this group. Research has suggested that some antidepressants may be effective in increasing cessation rates among persons with depression to levels similar to persons without depression. It is possible that nicotine treatment could be useful as a method of treating depression, given its effects upon the brain. While there appears to be a significant association between anxiety and smoking, there is an absence of validated strategies to assist persons with anxiety disorders to quit smoking. Further research is needed to explore methods by which this may be achieved. The strong relationship found between smoking and psychotic symptoms suggests that more work is needed to establish effective harm reduction methods for smokers with psychotic illnesses.

There was a consistent relationship between a range of measures of mental health and smoking. Smoking has consistently been found here to be a marker of poorer mental health. This suggests that public health initiatives could promote the message that those who seek help to give up smoking may have mental health problems. In particular, general practitioners and other health professionals need to consider the association between smoking and mental health, in particular when helping persons who are requesting assistance with smoking cessation.

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APPENDIX A: PREVALENCE OF MENTAL DISORDERS AND MEAN SCORE ON MEASURES OF PHYSICAL AND MENTAL WELL-BEING BY INVOLVEMENT WITH TOBACCO USE

Table 2: Prevalence (%) of DSM-IV mental disorders by tobacco use

	No current smoking	Current smoking
% Alcohol use disorder	3.7	13.1
% Cannabis use disorder	0.9	6.5
% Drug use disorder	0.4	2.3
% Anxiety disorder	4.5	9.4
% Affective disorder	5.4	11.1
% Psychosis screen +	0.5	2.3
% GHQ case +	11.2	15.8

Table 3: Prevalence (%) of DSM-IV mental disorders by tobacco use after adjusting for the effects of demographic and other drug use variables

	No current smoking	Current smoking
% Alcohol use disorder	4.4	6.3
% Cannabis use disorder	1.2	2.0
% Drug use disorder	0.6	0.8
% Anxiety disorder	5.7	6.8
% Affective disorder	7.1	8.1
% Psychosis screen +	0.8	1.2
% GHQ case +	12.2	16.5

Table 4: Mean scores on measures of physical and mental well-being by tobacco use

	No current smoking	Current smoking
GHQ score (M)	0.8	1.2
Kessler's PD scale (M)	46.2	44.6
SF-12 mental (M)	52.5	50.3
Delighted-Terrible (M)	2.7	3.0
BDQ score (M)	3.1	3.2

Table 5: Mean scores on measures of physical and mental well-being by involvement with tobacco use after adjusting for the effects of demographic and other drug use variables

	No current smoking	Current smoking
GHQ score (M)	1.0	1.1
Kessler's PD scale (M)	45.6	44.9
SF-12 mental (M)	51.6	50.8
Delighted-Terrible (M)	2.8	3.0
BDQ score (M)	3.1	3.4

APPENDIX B: ANALYSIS OF MEASURES OF MENTAL AND PHYSICAL WELL-BEING BY INVOLVEMENT WITH TOBACCO USE

Table 6: Univariate association between tobacco use and prevalence of mental health problems

	OR	95% CI
Alcohol disorder	3.95	3.35, 4.66
Cannabis disorder	7.64	5.70, 10.23
Drug use disorder	4.69	3.11, 7.09
Affective disorder	2.17	1.88, 2.51
Anxiety disorder	2.45	2.09, 2.87
Psychosis screen +	4.65	3.19, 6.76
GHQ case +	1.48	1.31, 1.67

Table 7: Association between tobacco use and mental health problems, adjusted for the effects of demographic variables

	OR	95%CI
Alcohol disorder	2.68	2.26, 3.21
Cannabis disorder	4.23	3.08, 5.78
Drug use disorder	2.97	1.93, 4.58
Affective disorder	1.58	1.33, 1.89
Anxiety disorder	1.70	1.40, 2.07
Psychosis screen +	2.92	1.97, 4.31
GHQ case +	1.14	0.99, 1.31

Table 8: Association between tobacco use and mental health problems, adjusted for the effects of demographic and drug use variables

	OR	95%CI
Alcohol disorder	2.25	1.88, 2.68
Cannabis disorder	3.56	2.60, 4.87
Drug use disorder	1.94	1.21, 3.10
Affective disorder	1.42	1.19, 1.69
Anxiety disorder	1.61	1.32, 1.95
Psychosis screen +	2.47	1.65, 3.75
GHQ case +	1.11	0.96, 1.27

Table 9: Univariate association between tobacco use and other measures of mental well-being

	Coefficient	SE	t	Sig t
GHQ score	.19	.02	8.54	<.00001
Kessler's PD scale	-.87	.06	-15.13	<.00001
SF-12 mental	-1.31	.10	-12.70	<.00001
Delighted-Terrible	.16	.01	13.31	<.00001
BDQ score	.08	.05	1.76	ns

Table 10: Association between tobacco use and other measures of mental well-being, adjusted for the effects of demographic variables

	Coefficient	SE	t	Sig t
GHQ score	.15	.04	3.60	<.0005
Kessler's PD scale	-.74	.09	-8.10	<.00001
SF-12 mental	-1.05	.18	-5.77	<.00001
Delighted-Terrible	.22	.02	9.66	<.00001
BDQ score	.30	.09	3.50	<.0005

Table 11: Association between tobacco use and other measures of mental well-being, adjusted for the effects of demographic and other drug use variables

	Coefficient	SE	t	Sig t
GHQ score	.06	.02	2.84	<.005
Kessler's PD scale	-.32	.05	6.85	<.00001
SF-12 mental	-.43	.09	4.62	<.00001
Delighted-Terrible	.10	.01	8.71	<.00001
BDQ score	-.12	.04	2.68	<.008