Alcohol, cannabis and tobacco use and the mental health of Australians: A comparative analysis of their associations with other drug use, affective and anxiety disorders, and psychosis

Louisa Degenhardt, Wayne Hall & Michael Lynskey

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NATIONAL SURVEY OF MENTAL HEALTH AND WELL-BEING

This is the seventh in a series of linked NDARC Technical Reports on various aspects of alcohol and drug use in 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).

Degenhardt, L., & Hall, W. (1999). The relationship between tobacco use, substance use disorders and mental disorders: Results from the National Survey of Mental Health and Well-Being (Technical Report No. 80).

Degenhardt, L., & Hall, W. (2000). The association between psychosis and problematic drug use among Australian adults: Findings from the National Survey of Mental Health and Well-Being (Technical Report No. 93).

Degenhardt, L., Hall, W., Teesson, M., & Lynskey, M. (2000). Alcohol use disorders in Australia: Findings from the National Survey of Mental Health and Well-Being (Technical Report No. 97).

Degenhardt, L., Hall, W. & Lynskey, M. (2000). Cannabis use and mental health among Australian adults: Findings from the National Survey of Mental Health and Well-Being, (Technical Report No. 98).

Degenhardt, L., Hall, W. & Lynskey, M. (2001). Alcohol, cannabis and tobacco use and the mental health of Australians: A comparative analysis of their associations with other drug use, affective and anxiety disorders, and psychosis. (Technical Report No. 103).

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EXECUTIVE SUMMARY

Alcohol, tobacco and cannabis are among the most commonly used psychoactive substances in the Western world. One issue that has received increasing attention in recent years concerns the comorbidity (or co-occurrence) of the use of these substances with other substance use and mental health problems. However, there appears to have been no comparison of the associations of these drug types with a range of mental health problems in the general population.

This study compared patterns of comorbidity of alcohol, cannabis and tobacco with other mental health problems, and with other drug use and drug use disorders. This was examined using data from the Australian National Survey of Mental Health and Well-Being (NSMHWB). The NSMHWB provided nationally representative data on Australians aged 18 years and over.

The following questions were asked:

1. What are the relationships between the level of involvement with use of alcohol, tobacco and cannabis, and:
    a. other drug use and DSM-IV drug use disorders;
    b. DSM-IV affective disorders;
    c. DSM-IV anxiety disorders;
    d. screening positively for psychosis?
2. What are the relative strengths of these associations?
3. Are these associations explained by demographic differences between users and non-users of cannabis, alcohol and tobacco?
4. Are these associations explained by different levels of other drug use between users and non-users of cannabis, alcohol and tobacco?
5. Are these associations explained by differences in neuroticism between users and non-users of cannabis, alcohol and tobacco?

In this general population sample, the strongest markers of other drug use were alcohol dependence and any involvement with cannabis use, with cannabis dependence being the strongest marker overall. Cannabis dependence was also the strongest marker of meeting criteria for another drug use disorder. In contrast, the strongest marker of anxiety and affective disorders was alcohol dependence. These findings did not appear to be explained by a number of other factors considered here. Cannabis dependence remained a significant marker of screening positively for psychosis. Tobacco smoking was a consistent marker of poorer mental health, remaining associated with higher rates of affective and anxiety disorders, substance use disorders, and screening positively for psychosis.

These findings suggest that different drug types are differentially associated with different patterns of comorbidity. These differential risks need to be taken into account in treatment. Further research is required to further examine these findings.

1 INTRODUCTION

Alcohol, tobacco and cannabis are among the most commonly used psychoactive substances in the Western world. In Australia, most adults have used alcohol at some point in their lives. In 1998, the Australian National Drug Strategy Household Survey produced estimates that around 9 in 10 persons aged 14 years and over had used alcohol at some point in their lives, with 83% having done so in the past year (Australian Institute of Health and Welfare, 1999). Current regular tobacco use was reported by 22% of persons, while 18% reported any cannabis use within the past year (Australian Institute of Health and Welfare, 1999).

1.1 WHAT IS A SUBSTANCE USE DISORDER?

While many users of psychoactive substances do so without experiencing any problems related to their use, some do develop problems. The conceptualisation – and measurement - of these problems has undergone considerable change. In the past three decades, the concept of a substance "dependence syndrome" has emerged, influenced by the work of Edwards and colleagues on alcohol dependence (Edwards & Gross, 1976).

In 1977, Edwards and colleagues suggested that alcohol dependence could be considered to be a cluster of symptoms occurring in heavy drinkers that were distinguishable from alcohol-related problems (Edwards, Gross, Keller, Moser, & Room, 1977). Seven factors were regarded as major symptoms of alcohol dependence:

- Narrowing of the behavioural repertoire;
- Salience of drinking (giving greater priority to alcohol use);
- Subjective awareness of a compulsion (experiencing loss of control over alcohol use, or an inability to stop using);
- Increased tolerance (using more alcohol to get the same effects, or finding that the same amount of alcohol has less effect);
- Repeated alcohol withdrawal symptoms (such as fatigue, sweating, diarrhoea, anxiety, trouble sleeping, tremors, stomach ache, headache, hallucinations, fever);
- Relief or avoidance of withdrawal symptoms by further drinking; and
- Reinstatement of dependent drinking after abstinence.

The concept of a dependence syndrome has since been extended to other drugs such as cannabis, tobacco, amphetamines and sedatives. The predominant classification of mental health in psychiatry has been redefined through successive versions of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders - DSM-I, DSM-II, DSM-III, DSM-III-R, and DSM-IV (American Psychiatric Association, 1952; 1968; 1980; 1987; 1994) The present study used the most recent - DSM-IV - operationalisations of the substance abuse and dependence syndromes.

DSM-IV Substance Abuse criteria require a pattern of substance use that is causing clinically significant distress or impairment (American Psychiatric Association, 1994). This distress or impairment may involve: a failure to fulfil role obligations due to

substance use; substance use in hazardous situations, or legal, social or interpersonal problems resulting from substance use.

DSM-IV Substance Dependence criteria require a cluster of three or more indicators that a person continues to use the substance despite significant substance related problems (American Psychiatric Association, 1994). These include: tolerance to the effects of the substance; a withdrawal syndrome on ceasing or reducing use; using the substance in larger amounts or for a longer period than intended; a persistent desire or unsuccessful efforts to reduce or cease use of the substance; a disproportionate amount of time spent obtaining, using and recovering from substance use; social, recreational or occupational activities are reduced or given up due to substance use; and continuing substance use despite knowledge of physical or psychological problems caused by such use.

1.2 WHAT IS COMORBIDITY?

The issue of comorbidity between substance use disorders and mental disorders has gained increasing prominence in psychiatry and psychology within the past few decades [Wittchen, 1996 #121]. This has accompanied a move away from less well-defined concepts of mental health and psychopathology to classification systems of increasing specificity, along with an increasing awareness of problems with hierarchical diagnostic systems such as those developed by Kraeplin (Boyd, Burke, Gruenberg, & al., 1984; Klerman, 1990).

"Comorbidity" was defined by Feinstein as "any distinct clinical entity that has co-existed or that may occur during the clinical course of a patient who has the index disease under study" (p.456-7) (Feinstein, 1970). Comorbidity is commonly used to refer to the overlap of two or more psychiatric disorders (Boyd et al., 1984).

More recent work has distinguished between two types of comorbidity. *Homotypic comorbidity* refers to the co-occurrence of disorders within a diagnostic grouping (Angold, Costello, & Erkanli, 1999). The co-occurrence of two different substance use disorders (e.g. cannabis and alcohol) may be thought of as homotypic comorbidity. *Heterotypic comorbidity* refers to the co-occurrence of two disorders from different diagnostic groupings (Angold et al., 1999). This might include, for example, the co-occurrence of a substance use disorder and an anxiety disorder.

The focus of this study is to compare the patterns of comorbidity of alcohol, cannabis and tobacco with other mental health problems, and with other drug use and drug use disorders.

1.3 WHAT DO WE KNOW ABOUT THE COMORBIDITY OF ALCOHOL, CANNABIS AND TOBACCO USE WITH OTHER MENTAL HEALTH PROBLEMS?

There has been a considerable amount of research conducted on the relationship between substance use and other mental health problems (for a more comprehensive review of this evidence, see Appendix A). In general, the evidence to date suggests that people who are problematic users of one substance are more likely to have a range of other mental health problems, such as depression, anxiety, psychosis and other substance use problems. However, there appears to have been no previous examination of how

different drugs are comparatively related to other mental health problems. Hence, we do not have much information on how different drugs compare for the strength of their relationship with other mental health problems. This comparative approach has previously been adopted to compare drugs' dependence liability, as well as the relative risks of a range of physical health problems.

If we can directly compare different drug types for their relationships with mental health problems, we can begin to gain an understanding of whether involvement with *any* drug is a marker of comorbidity in general, of if different drugs are related to other mental health problems differentially. This has implications for theories of the aetiology of comorbidity, for treatment, and for public health, since it may indicate that interventions for different mental health problems should be targeted for different substance using populations.

1.4 WHY EXAMINE COMORBIDITY BETWEEN SUBSTANCE USE AND MENTAL HEALTH?

There are several good reasons to examine links between drug use and mental health. The first is a theoretical one: if mental health problems are more likely to occur among those with substance use disorders, this raises important questions about the aetiology of mental disorders and of substance use disorders. The second is a public health issue: if it is the case that substance use and misuse is associated with other mental health problems, this has implications for service provision and for the well-being of members of the community. The final reason is a clinical one: if a person with a substance use problem is likely to have other mental health problems, then someone presenting for treatment for one problem may also require treatment for other mental health problems they are experiencing. This has implications for both assessment and for the efficacy of treatment for substance use problems if other problems go untreated.

1.5 EXPLANATIONS OF COMORBIDITY

It is necessary to distinguish between "artefactual" comorbidity and "true" comorbidity. Artefactual comorbidity is comorbidity that arises because of the ways in which samples are selected or the behaviour is conceptualised, measured and classified (Caron & Rutter, 1991). For example, artefactual comorbidity would occur if lists of diagnostic criteria of different disorders include the same symptoms (Caron & Rutter, 1991).

The population studied will also affect observed patterns of comorbidity. Research with clinical populations provides important information about disorder patterns among persons in treatment, but for a number of reasons, they may not be representative of those in the general population. The first is that Berkson's bias may operate (Berkson, 1946). This refers to the fact that if a person has two disorders at a given point in time, then they are more likely to receive treatment simply because there are two separate disorders for which they might seek help. The second reason has been called a clinical bias (Galbaud Du Fort, Newman, & Bland, 1993). This refers to the fact that persons who have two disorders may be more likely to seek treatment *because* they have two disorders. Both these sources of bias (Berkson's bias and clinical bias) have been demonstrated empirically (Galbaud Du Fort et al., 1993; Roberts, Spitzer, Delmore, &

Sackett, 1978). Third, referral biases may exist, whereby some persons will be referred for treatment because of other factors, such as a family history of psychopathology (Caron & Rutter, 1991).

In representative general population samples these biases do not exist, so observed patterns better reflect general relationships between mental health problems. Hence, general population patterns will not be affected by the above sources of *artefactual* comorbidity that might occur due to referral and sample selection biases. The present study uses a general population sample to examine patterns of comorbidity, so we may be confident that the patterns of comorbidity observed will be free from the above artefactual biases.

True comorbidity refers to the actual co-occurrence of two separate conditions. There are a number of reasons why two disorders might co-occur (Caron & Rutter, 1991; Kessler, 1995). First, there may be a causal relationship between the two, with the presence of one disorder making another more likely to develop. For instance, persons could develop substance use problems from their attempts to self-medicate an existing mental health problem. It has been argued that some persons use drugs such as alcohol in an attempt to relieve anxiety or distress, with problematic use becoming more likely when alcohol reduces these negative states (Cappell & Greeley, 1987). It has also been hypothesised that persons with schizophrenia use tobacco as a form of self-medication, 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).

Another causal hypothesis is that substance use problems can precipitate mental health problems. For example, there is evidence to suggest that some persons develop depression secondary to alcohol dependence (Schuckit et al., 1997a; Schuckit et al., 1997b); such secondary disorders are more likely to remit with abstinence from alcohol (Brown & Schuckit, 1988). Comorbidity between drug use problems has also been discussed in causal terms. For instance, there has been some speculation that the use of some drug types leads to the later use of others: this "gateway" or stage hypothesis has been proposed to explain relationships between cannabis use and the use of other drugs (Kandel & Faust, 1975).

Second, an indirect causal relationship may also exist, whereby the effects of a disorder upon some other factor may increase the likelihood of a second disorder. For example, research has shown that the presence of early-onset substance use disorders reduces the likelihood of completing high school, entering college and completing college (Kessler, Foster, Saunders, & Stang, 1995). Difficulties encountered because of poor educational achievement may subsequently increase the likelihood of other problems, such as depression or continued drug use problems.

A third possibility is that there may *not* be a causal relationship between two disorders: rather, it may be that common or associated risk factors are shared (Caron & Rutter, 1991; Kessler, 1995), both environmental and genetic risk factors. Research suggests that genetic factors increase the risk of substance use disorders (Heath, Madden, Slutske, & Martin, 1995; Kendler et al., 1999; Kendler, Heath, Neale, Kessler, & Eaves, 1992a; Kendler, Neale, Heath, Kessler, & Eaves, 1994; Kendler & Prescott, 1998b; Kendler et al., 1995; True et al., 1999). It is possible that these factors are common across different drug types (thus playing a part in homotypic comorbidity). This is supported by evidence

showing that nicotine and alcohol dependence are affected by common genetic and environmental vulnerabilities (True et al., 1999). Multiple drug problems might be influenced by a common neurophysiological trait, given that different drugs act upon similar brain loci and upon the same neurotransmitter systems (Koob & LeMoal, 1997; Krishnan-Sarin, Rosen, & O'Malley, 1999; Nutt, 1997).

There is also some evidence that there are common causes of substance use disorders and mental disorders (i.e. for heterotypic comorbidity). For example, research has suggested that common genetic factors increase the risk of alcohol dependence and anxiety and affective symptoms (Tambs, Harris, & Magnus, 1997), as well as nicotine dependence and major depression (Kendler et al., 1993a). Shared environmental factors may also increase the likelihood of both alcohol dependence and major depression among women (Tambs et al., 1997).

The first step is to rule out the possibility that the relationship between two disorders is based on common risk factors (or perhaps on indirect effects of one upon the other). This may be done by measuring and statistically adjusting for factors that are related to substance use and which may affect the association between substance use and mental health. There are a number of individual characteristics that have been associated with an increased likelihood of substance use.

Drug use is strongly related to gender: males are more likely to use and misuse drugs than females (Anthony & Helzer, 1991; Anthony, Warner, & Kessler, 1994; Bijl, Ravelli, & van Zessen, 1998; Greenfield & O'Leary, 1999; Helzer, Burnam, & McEvoy, 1991; Kandel, Chen, Warner, Kessler, & Grant, 1997; Kessler et al., 1997).

Age is also a strong predictor of substance use: it 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). Recent research showed that there was a decline in the number of symptoms of depression and anxiety with age (Henderson et al., 1998).

Educational attainment has been negatively correlated with involvement with alcohol (Crum, Bucholz, Helzer, & Anthony, 1992; Crum, Helzer, & Anthony, 1993; Fillmore et al., 1998; Helzer et al., 1991; Kandel et al., 1997) as well as with cannabis and tobacco (Kandel et al., 1997; Robins & Regier, 1991), although the precise mechanisms of the relationship between educational attainment and cannabis use are uncertain (Lynskey & Hall, 2000). Lower educational attainment has also been associated with a greater likelihood of meeting criteria for a psychiatric disorder (Kessler et al., 1995).

Employment status has also been associated with alcohol abuse, with those who are unemployed more likely to abuse alcohol (Fillmore et al., 1998; Helzer et al., 1991). The unemployed are also more likely to use tobacco and cannabis (Giovino, Henningfield, Tomar, Escobedo, & Slade, 1995; Kandel et al., 1997), although the relationship with cannabis use is inconclusive (Hall, Johnston, & Donnelly, 1999). Depression has also been related to employment status. An analysis of the ECA data revealed that of those who were not depressed at first interview, those who became unemployed by the time of the second interview were twice as likely to have depressive symptoms (Dooley, Catalano, & Wilson, 1994). In contrast, those who were depressed at time 1 were not at increased risk of becoming unemployed by time 2.

There is some evidence that psychiatric disorders and marital status are related (Kessler, Walters, & Forthofer, 1998). Research has suggested that persons with psychiatric disorders – anxiety, depressive and substance use disorders – were more likely to marry at an early age, which is associated with a range of negative outcomes. Those who met criteria for psychiatric disorders were also less likely to have married "on-time" or later on, both of which are associated with more positive factors (Forthofer, Kessler, Story, & Gotlib, 1996).

Temperament may also be associated with drug use, particularly the trait of neuroticism. Persons scoring highly on measures of neuroticism are more anxious, worrying, depressed and moody (Eysenck & Eysenck, 1991). Anxiety and depression are also strongly related to higher levels of trait neuroticism (Kendler, Neale, Kessler, Heath, & Eaves, 1992b; Martin, 1985). Research has shown that persons who are more involved with alcohol use are likely to have higher neuroticism than those who are less involved (Ogden, Dundas, & Bhat, 1989; Prescott, Neale, Corey, & Kendler, 1997; Rankin, Stockwell, & Hodgson, 1982; Sieber & Angst, 1990). Research with young adults has found an association between more frequent use of cannabis and higher levels of neuroticism (higher mean N scores on the EPQ) (Sieber & Angst, 1990; Wells & Stacey, 1976). Similarly, persons with cannabis dependence have been found to have significantly higher than normal N scores (Bachman & Jones, 1979). While early research studies provided conflicting evidence on the relationship between neuroticism and smoking (Eysenck, 1963; Golding, Harpur, & Brent-Smith, 1983; Haines, Imeson, & Meade, 1980; Sieber, 1981; Spielberger & Jacobs, 1982), 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, there is the possibility that links between the use of one type of substance use disorder and mental health may be affected by comorbidity with other substance use, or other mental health problems. In other words, associations between the use of a substance and a mental health problem could be affected by homotypic comorbidity. This is possible given that persons who use one drug type are more likely than non-users to use other drugs (Hays, Farabee, & Miller, 1998; Helzer et al., 1991; Henningfield, Clayton, & Pollin, 1990; Kessler et al., 1997). Further, it could be that associations between a mental health problem and use of a substance are largely due to comorbidity between mental health problems. This is also possible given, for example, the overlap observed between anxiety and affective disorders (Blazer, Hughes, George, Swartz, & Boyer, 1991).

Any examination of relationships between substance use and mental health must take these possible common factors into account. The present study will accordingly examine some common factors that could explain the co-occurrence of cannabis, alcohol and tobacco use and mental health problems. These potential common factors include demographic characteristics of users and the personality trait of neuroticism.

1.6 AIMS

Many analyses focus on a single drug type and explore the patterns of comorbidity with other mental health problems. While this provides important information about persons who use a certain drug type, a couple of issues arise:

1. If other drug use is not considered, it is possible that the observed rates of other mental health problems reflect the use of other drugs, or polydrug use;
2. There is no direct comparison of the relative strength of the association between the use of different drug types and other mental health problems. Comparative analyses have previously been useful in making estimates of the relative dependence potential of different drug types (Anthony et al., 1994). To date, no comparison appears to have been made of the patterns of comorbidity of different drug types.

The NSMHWB provided nationally representative data on the mental health of Australian persons aged 18 years and over. This means that we can be confident that the results found are representative of the community in general. It also involved the assessment of participants with standardised diagnostic criteria that have been shown to be reliable and valid.

In the present study, the following questions were posed:

1. In the general population, what are the relationships between the level of involvement with use of alcohol, tobacco and cannabis, and the following indices of mental well-being:
   a. other drug use and DSM-IV drug use disorders;
   b. DSM-IV affective disorders;
   c. DSM-IV anxiety disorders;
   d. screening positively for psychosis?
2. What are the relative strengths of these associations?
3. Are these associations explained by demographic differences between users and non-users of cannabis, alcohol and tobacco?
4. Are these associations explained by different levels of other drug use between users and non-users of cannabis, alcohol and tobacco?
5. Are these associations explained by differences in neuroticism between users and non-users of cannabis, alcohol and tobacco?

2 METHOD

The NSMHWB sample was a representative sample of residents in private dwellings across all States and Territories in Australia, conducted by the Australian Bureau of Statistics (ABS) in 1997. The sample excluded special dwellings (hospitals, nursing homes, hostels etc.), and dwellings in remote and sparsely populated areas of Australia. Dwellings were selected using random stratified multistage area sampling, so that each person in all States and Territories had a known chance of participation. One person aged at least 18 years was randomly selected from each dwelling and asked to participate. Approximately 13,600 private dwellings were approached, with a final sample size of 10,641 persons giving a response rate of 78%.

Trained survey interviewers met with each designated respondent to administer the interview. The interviewers were given 24-hour access to a psychiatrist to deal with any concerns that arose in the course of the interview.

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 both ICD-10 and DSM-IV disorders. The CIDI is the most widely used interview in large epidemiological studies (Bland, Newman, & Orn, 1988; Robins & Regier, 1991) and CIDI assessments of substance use disorders have been shown to have excellent inter-rater reliability (Cottler et al., 1991; Wittchen et al., 1991) and test-retest reliability (Andrews & Peters, 1998; Cottler et al., 1991; Wittchen et al., 1991). There are fewer studies of the validity of the CIDI assessments for substance use disorders (Andrews & Peters, 1998). In an early study comparing the agreement between the Present State Examination (PSE) and CIDI interviews the agreement for syndromes was adequate (Overall Kappa =0.55) (Farmer, Katz, McGuffin, & Bebbington, 1987). Similarly, Janca et al. (1992) found good levels of agreement between CIDI and clinicians' assessments (Kappa = 0.77). The validity of the CIDI has been further supported by broad agreement between the findings of the ECA and the NCS (Bland et al., 1988; Robins & Regier, 1991). Thus, while community epidemiological surveys may not provide perfect estimates of the prevalence of mental disorders in the community they provide a reasonably reliable and valid portrait of the pattern of disorders in the community.

2.1 ASSESSMENT OF ALCOHOL, CANNABIS AND OTHER DRUG USE

Respondents were asked if they had consumed at least 12 standard drinks (10g alcohol) within the past 12 months. All those who reported such use, and who had consumed more than 3 standard drinks on one occasion, were assessed for alcohol use disorders. All persons were asked whether they currently used tobacco; if so, they were asked if their use was regular (at least daily). 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 symptoms of abuse and dependence.

Respondents were asked separate questions about their use of other drugs including cannabis, stimulants, sedatives and opioids. The questions asked about the use of drugs such as marijuana and the "extramedical use" of prescribed drugs such as

benzodiazepines. The questions asked whether drugs and medicines had been used "in larger amounts than was prescribed or for a longer period than was prescribed" or used "more than five times when they were not prescribed for you, to get high, to relax, or to make you feel better, more active, or alert". Additional questions covered age of onset of use, frequency and recency of use of each of four drug groups. The drug groups were selected to reflect the most widely used extramedical drugs among Australian adults, as indicated in the Australian National Drug Strategy Household surveys (Makkai & McAllister, 1998) and included:

- *cannabis* (marijuana & hashish);
- *stimulants*: amphetamines, ecstasy, speed and other stimulants which can be obtained by medical prescription including, dexedrine, preludin and ritalin;
- *sedatives*: barbiturates and tranquillisers and other sedatives which can be obtained by medical prescription including, ativan, librium, megaton, normison, rohypnol, serepax, valium, xanax;
- *opioids* such as heroin and opium as well as other opioids and analgesics which can be obtained on medical prescription including, codeine, doloxene, methadone, morphine, percodan and pethidine.

Respondents were given a detailed verbal description of each drug group and lists of drugs in each class. The interviewer read the questions and recorded the participants' responses on a laptop computer. This use of a computer to record answers in real-time differed from the ECA and NCS, which used pencil and paper. Studies have since shown excellent agreement between responses recorded via pencil and paper and those recorded via laptop computer (Peters, Clarke, & Carroll, 1999).

2.2 DIAGNOSTIC ASSESSMENT OF MENTAL DISORDERS

The following DSM-IV disorders were assessed in the interview:

1. Substance use disorders: abuse and dependence on alcohol, cannabis, opiates, 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.

2.2.1 DIAGNOSTIC ASSESSMENT OF SUBSTANCE USE DISORDERS

DSM-IV Abuse criteria require a pattern of substance use that is causing clinically significant distress or impairment. This distress or impairment may involve a failure to fulfil role obligations, use in hazardous situations, or legal, social or interpersonal problems.

DSM-IV Dependence criteria require a cluster of three or more indicators that a person continues use despite significant substance related problems. These include: tolerance to the effects of alcohol or other drugs; a withdrawal syndrome on ceasing or reducing use; substance used in larger amounts or for a longer period than intended; a persistent desire or unsuccessful efforts to reduce or cease use; a disproportionate amount of time spent obtaining, using and recovering from use; social, recreational or occupational activities

are reduced or given up due to substance use; and use continues despite knowledge of physical or psychological problems induced by substance use.

2.2.2 DIAGNOSTIC ASSESSMENT OF ANXIETY DISORDERS

If respondents reported that they had an unusually strong fear or avoidance of a range of social situations in the past 12 months, they were assessed for DSM-IV social phobia. All persons were asked if they had had an unusually strong fear or avoidance of situations, such as being outside home alone or on a bus. If so, they were assessed for symptoms of DSM-IV agoraphobia. All persons were asked if they had had attacks of fear in which they felt anxious, frightened or very uneasy, which did not occur in a life-threatening situation and which was unexpected; if so, they were assessed for symptoms of DSM-IV panic disorder. All persons were asked if they had had a period of at least one month in the past year when they felt generally anxious or worried, and if so, they were asked about symptoms of DSM-IV generalised anxiety disorder.

Persons who reported they had been bothered by recurrent unpleasant and persistent thoughts in the past 12 months were assessed for DSM-IV obsessive-compulsive disorder. Finally, all persons were asked if they had ever experienced a range of extremely stressful or upsetting events (such as being in combat, being sexually assaulted); those who had were assessed for DSM-IV posttraumatic stress disorder.

2.2.3 DIAGNOSTIC ASSESSMENT OF AFFECTIVE DISORDERS

All persons were asked if they had had a period of at least 2 weeks in the past 12 months when they had felt sad or depressed, or had lost interest in most things. Those who had were assessed for DSM-IV major depression. All persons were asked if they had had a period of at least 2 years where they felt sad or depressed most days, without having an interruption of such feelings for 2 months. Those who reported this, and for whom the period had extended into the past year, were assessed for DSM-IV dysthymia. Persons were assessed for DSM-IV bipolar I and II disorders if they reported a period of at least 4 days where they were so happy or excited that they got into trouble or friends/family were concerned.

2.3 PSYCHOSIS SCREENER

The psychosis screener was developed for use in the NSMHWB. It used elements of the CIDI to assess the presence of characteristic psychotic symptoms. It comprised 7 items (see Table 1), three of which (1a, 2a, 3a) were asked only if the respondent endorsed a previous question (1, 2, 3 respectively). The first 6 items covered the following features of psychotic disorders: delusions of control, thought interference and passivity (Question 1 and 1a); delusions of reference or persecution (Question 2 and 2a); and grandiose delusions (Question 3 and 3a). The final item (Question 4) assessed whether a respondent had ever received a diagnosis of schizophrenia. Scores on the screener ranged from zero to a maximum of six. An analysis of the effectiveness of this screener in detecting cases of schizophrenia or schizoaffective disorders has been carried out, using a sample of persons from an inpatient psychiatric setting, and a sample of persons

from a variety of mental health services[1]. This analysis indicated that scores of three or more discriminate adequately between cases and non-cases of schizophrenia or schizoaffective disorder.

Table 1: Questions included in the psychosis screener

1. In the past 12 months, have you felt that you thoughts were being directly interfered with or controlled by another person?
1a. Did it come about in a way that many people would find hard to believe, for instance, through telepathy?
2. In the past 12 months, have you had a feeling that people were too interested in you?
2a. In the past 12 months, have you had a feeling that things were arranged so as to have a special meaning for you, or even that harm might come to you?
3. Do you have any special powers that most people lack?
3a. Do you belong to a group of people who also have these special powers?
4. Has a doctor ever told you that you may have schizophrenia?

2.4 DATA ANALYSIS

2.4.1 ALCOHOL USE CLASSIFICATION

Those classified as having used alcohol were persons who reported drinking 12 or more standard drinks (each 10g alcohol) within the past 12 months. Those who reported such alcohol use are divided into three groups: those who drank without meeting criteria for a use disorder ("alcohol use"), those who met criteria for DSM-IV alcohol abuse without dependence ("alcohol abuse"), and those who met criteria for DSM-IV alcohol dependence ("alcohol dependence"). Hence, a four-level variable was created: no alcohol use in the past 12 months, alcohol use without meeting criteria for a DSM-IV disorder, meeting criteria for DSM-IV alcohol abuse, and meeting criteria for DSM-IV alcohol dependence.

2.4.2 CANNABIS USE CLASSIFICATION

Involvement with cannabis use was categorised as a four level variable: fewer than 6 occasions of use in the past 12 months (termed "no use"), more frequent use without

[1] Unpublished analyses; contact the authors of this paper for further details.

meeting criteria for DSM-IV abuse or dependence ("cannabis use"), DSM-IV cannabis abuse, and DSM-IV cannabis dependence.

Prevalence estimates were weighted to conform to independent population estimates by State, part of State, age and sex. In addition, balanced repeated replicate weights were used to account for the complex survey sampling design. Prevalence estimates and their standard errors were calculated using SUDAAN Version 7.5.3 (Research Triangle Institute, 1997).

2.4.3 MULTIPLE REGRESSIONS

Multiple logistic regressions were carried out for each dichotomous outcome variable (e.g. presence/absence of a DSM-IV affective disorder). All analyses were carried out using STATA 5.0 for Windows (STATA Corporation, 1997). In these analyses, the following steps were carried out:

1. A logistic regression in which only alcohol, cannabis and tobacco use variables were included.

This was followed by a series of multiple logistic regression analyses in which the following sets of variables were added in the regression model at each subsequent step:

2. Demographic variables:
   a. Gender (reference category: female);
   b. Age (reference category: 18-24 years, compared to 25-34, 35+);
   c. Education (reference category: completed less than secondary education; compared to completed secondary education, completed post-secondary education);
   d. Marital status (reference category: currently married/defacto; compared to separated/divorced/widowed/never married);
   e. Employment status (reference category: employed full-time/part-time; compared to unemployed/ not in the labour force).

3. Other drug use: stimulant, sedative or opiate use in the past 12 months (reference category: no use). Note that in analyses examining other drug use, this variables was not included

4. EPQ Neuroticism score.

3 RESULTS

3.1 PREVALENCE OF ALCOHOL, CANNABIS AND TOBACCO USE

Table 1 shows the weighted prevalence of the use categories of the three drug classes. Alcohol was the most widely used drug class, with two thirds of Australian adults (68%) reporting they had used alcohol in the past year without meeting criteria for a use disorder, and a further 6% meeting criteria for alcohol abuse or dependence.

One quarter (25%) of Australian adults reported current tobacco use. One in twenty persons (5%) reported cannabis use without meeting criteria for a use disorder, while around 2% met criteria for a cannabis use disorder in the past year.

Table 1: Weighted prevalence of alcohol, cannabis and tobacco use

	Prevalence (SE)	
No alcohol use	26.5	(0.5)
Alcohol use	67.5	(0.6)
Alcohol abuse	1.9	(0.2)
Alcohol dependence	4.1	(0.3)
No cannabis use	92.8	(0.4)
Cannabis use 5+ times	4.8	(0.3)
Cannabis abuse	0.7	(0.1)
Cannabis dependence	1.5	(0.2)
No current tobacco use	75.1	(0.6)
Tobacco use	24.9	(0.6)

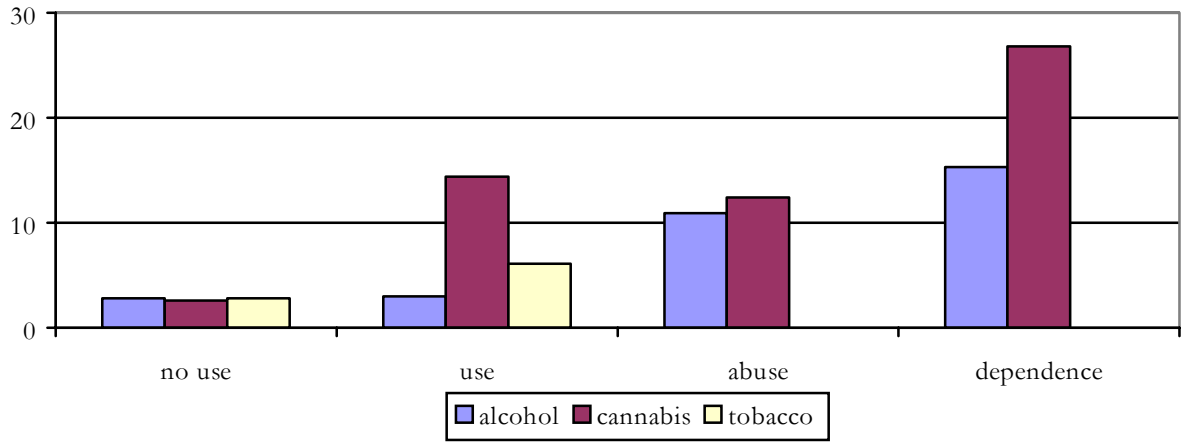
3.2 COMORBIDITY WITH OTHER DRUG USE AND USE DISORDERS

Figure 1 shows the prevalence of the use of sedatives, stimulants or opiates within the past 12 months, according to the level of involvement with cannabis, alcohol and tobacco (see also Appendix B for details). In all figures presented, tobacco use has been placed in the "use" category, as nicotine dependence was not assessed. Nonetheless, it is likely that a significant proportion of persons who reported using tobacco would have met criteria for nicotine dependence.

Cannabis users were all much more likely to report using at least one of these other drug types (cannabis use 14%, cannabis abuse 12%, cannabis dependence 27%) compared to non-users (3%), with odds ratios ranging from 5.4 – 11.3.

The association with alcohol use was less strong (Figure 1, Table 2). Alcohol use (without disorder) was not associated with an increased likelihood of using sedatives, stimulants or opiates. Those meeting criteria for alcohol abuse or dependence were more likely than users/non-users to report use of these other drug types (ORs 4.1, 7.3 respectively). Tobacco use was associated with a doubling of the likelihood of having used these other drug types (6% vs. 3%, OR 2.3).

Figure 1: Prevalence of sedative/stimulant/opiate use according to level of involvement with alcohol, cannabis and tobacco



A similar pattern emerged when considering other drug use disorders. Cannabis use (regardless of the level of involvement) was strongly associated with problematic drug use (Figure 2, Table 2, Appendix B). By far the strongest marker of other drug use disorders was cannabis dependence, which was associated with a 34.5 times greater likelihood of meeting criteria for another drug use disorder (compared to non-users of cannabis). Those who were alcohol dependent were 10 times more likely to meet criteria for another drug use disorder than non-drinkers (Table 2). The other alcohol use groups (use and abuse) did not differ significantly form non-users of alcohol in the likelihood of meeting criteria for another drug use disorder. Tobacco use, in contrast, was a significant marker of increased risk of meeting criteria for another drug use disorder, with increased odds relative to non-users of 4.7 (95%CI 3.1, 7.1).

Figure 2: Prevalence of sedative/stimulant/opiate use disorders according to level of involvement with alcohol, cannabis and tobacco

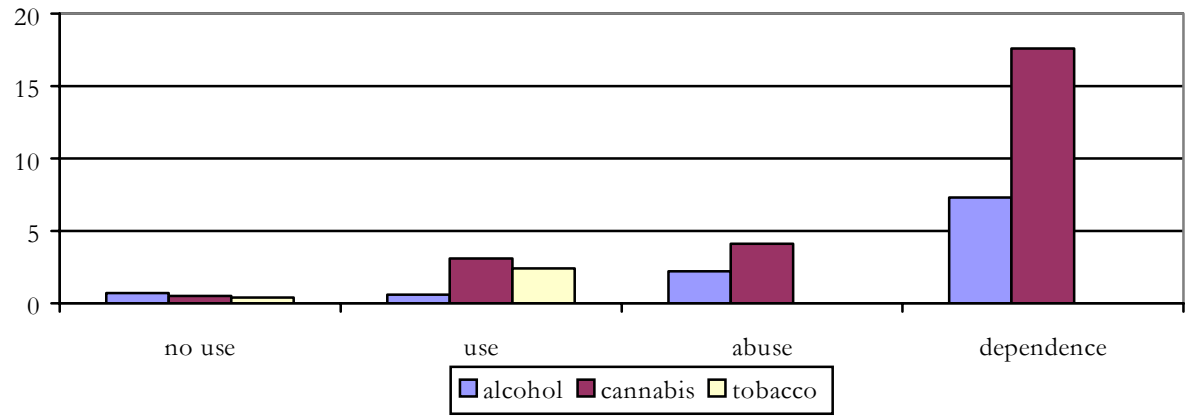


Table 2 also shows the odds ratios between alcohol, tobacco and cannabis use and other drug use, after accounting for other factors that may have explained the higher rates of other drug use among cannabis, alcohol and tobacco users. After adjusting for these other factors (demographics and neuroticism), tobacco use was no longer associated with an increased likelihood of using sedatives, stimulants or opiates (OR 1.2, 95%CI 0.95, 1.53). In contrast, all levels of cannabis involvement remained associated with an increased likelihood of using these other drug types in multivariate analysis, with adjusted odds ratios of between 3.2 and 6.8. Alcohol abuse and alcohol dependence also remained associated other drug use: those meeting criteria for alcohol abuse or dependence were still around 3 times more likely than non-users to report using at least one of these other drug types.

While the strength of these relationships was significantly reduced in all cases, the relative patterns changed very little after controlling for demographics and neuroticism. Those who were cannabis dependent still had the highest increased odds, relative to non-users, of meeting criteria for other drug use disorders (OR = 14.0). Those meeting criteria for alcohol dependence (OR 2.7) and tobacco users (OR 1.9) still had increased odds; cannabis use (OR 3.1) was still associated with meeting criteria for another drug use disorder. Although the odds ratio for cannabis abuse was no longer significant, this may have been due to the small sample size and corresponding lack of precision of the estimates (OR 3.1, 95%CI 0.8, 10.9).

Table 2: Adjusted odds ratios (OR) and 95% confidence intervals (95%CI) for other drug use according to alcohol, cannabis and tobacco use

	Adjusted OR	Adjusted 95%CI
Sedative, stimulant or opiate use		
No alcohol use	1.00	--
Alcohol use	1.29	0.97, 1.71
Alcohol abuse	2.55	1.41, 4.57
Alcohol dependence	3.06	2.07, 4.57
No cannabis use	1.00	--
Cannabis use	4.38	3.18, 6.04
Cannabis abuse	3.22	1.55, 6.75
Cannabis dependence	6.75	4.25, 10.70

No tobacco use	1.00	--
Tobacco use	1.21	0.95, 1.53
Sedative, stimulant, opiate use disorder		
No alcohol use	1.00	--
Alcohol use	0.77	0.44, 1.34
Alcohol abuse	1.20	0.37, 3.86
Alcohol dependence	2.73	1.41, 5.26
No cannabis use	1.00	--
Cannabis use	3.10	1.63, 5.90
Cannabis abuse	3.10	0.84, 10.91
Cannabis dependence	14.00	7.38, 26.74
No tobacco use	1.00	--
Tobacco use	1.90	1.24, 3.19

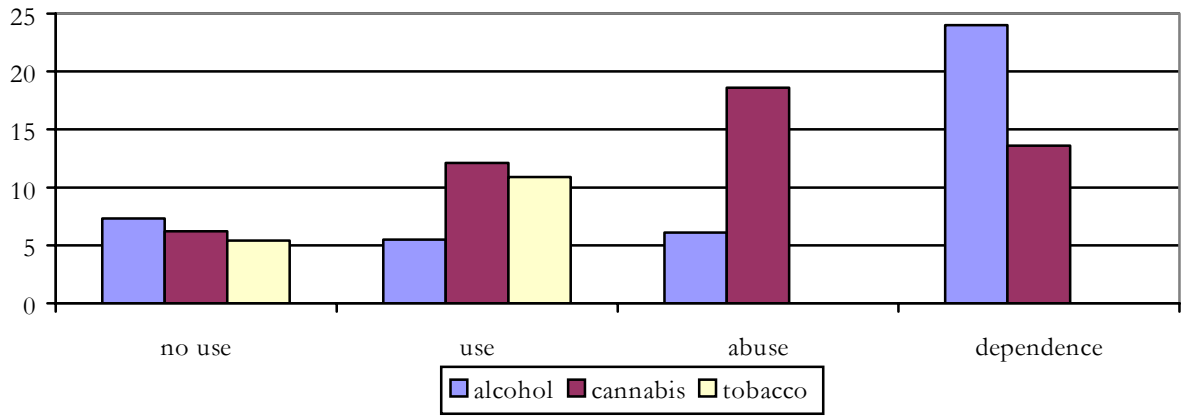
3.3 DEPRESSION AND ANXIETY

Figure 3 shows the prevalence of DSM-IV affective and anxiety disorders according to alcohol use, cannabis use and tobacco use, as well as univariate odds ratios of these disorders among users compared to non-users (see Appendix B for tables).

The prevalence of affective disorders was increased among those who met criteria for alcohol dependence, compared to non-drinkers. Alcohol dependent persons were 4.5 times more likely to meet criteria for an affective disorder than non-drinkers (24% vs. 7%, respectively). In contrast, however, those who reported drinking without meeting criteria for an alcohol use disorder had a significantly *lower* rate of affective disorders compared to non-drinkers (5.5% vs. 7.3%). Those meeting criteria for alcohol abuse (6%) did not differ from non-drinkers in the proportion who met criteria for an affective disorder (Figure 3).

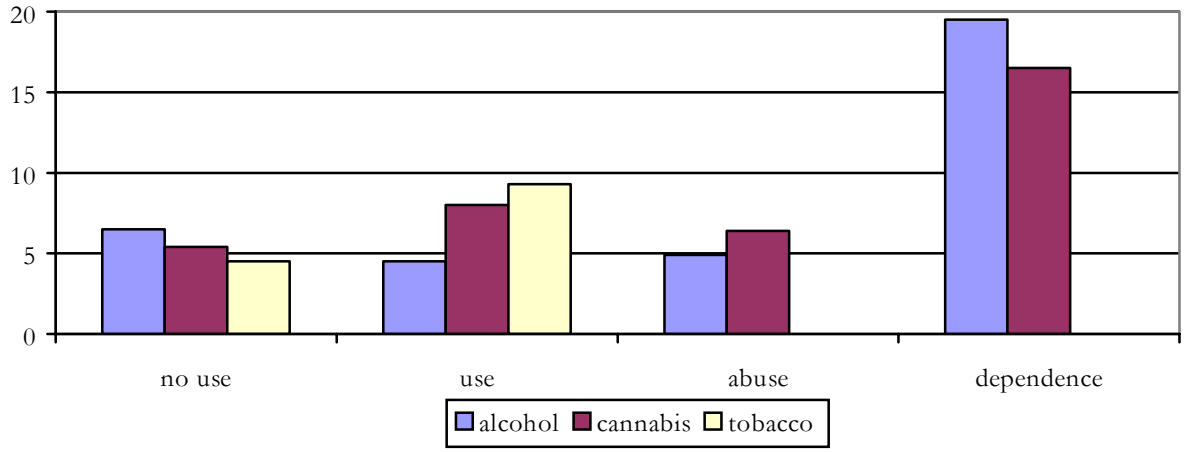
In comparison, cannabis use of all levels was associated with higher rates of affective disorders, with odds ratios of between 2.2 and 2.9 compared to non-users (Table 3). Tobacco use was also associated with a doubling of the likelihood of meeting criteria for an affective disorder (OR 2.2).

Figure 3: Prevalence of affective disorders according to level of involvement with alcohol, cannabis and tobacco



A similar pattern was observed for anxiety disorders (Figure 4). Alcohol dependence and cannabis dependence were associated with similarly increased risks of anxiety disorder (OR 4.4 and 4.3, respectively), while tobacco use was associated with a 2.4 times greater chance of meeting criteria for an anxiety disorder (Table 3). Alcohol users who did not meet criteria for an alcohol use disorder were *less* likely to have an anxiety disorder than non-drinkers (4.5% vs. 6.5% respectively), while those meeting criteria for alcohol abuse did not have a significantly different risk of meeting criteria for an anxiety disorder compared to non-drinkers (Figure 4).

Figure 4: Prevalence of anxiety disorders according to level of involvement with alcohol, cannabis and tobacco



These patterns changed markedly after multiple regression analysis (Table 3). *No level of cannabis use* was associated with an increased risk of meeting criteria for an affective disorder after the effects of demographics, other drug use and neuroticism were considered. The significant univariate association disappeared after considering tobacco, alcohol and cannabis and other drug use simultaneously.

In contrast, alcohol dependence and tobacco use remained associated with a higher likelihood of meeting criteria for an affective disorder. Alcohol dependent persons were still twice as likely to meet criteria for an affective disorder (OR 2.0), while tobacco users were still 1.5 times as likely.

As can be seen in Table 3, cannabis use was not associated with anxiety disorders after adjustment for other factors. This relationship disappeared after including alcohol, tobacco and other drug use in the analysis. Alcohol use and abuse were also not significantly associated with anxiety disorders. In contrast, alcohol dependence and tobacco use remained significant markers of anxiety disorders (OR 1.9 and 1.7, respectively).

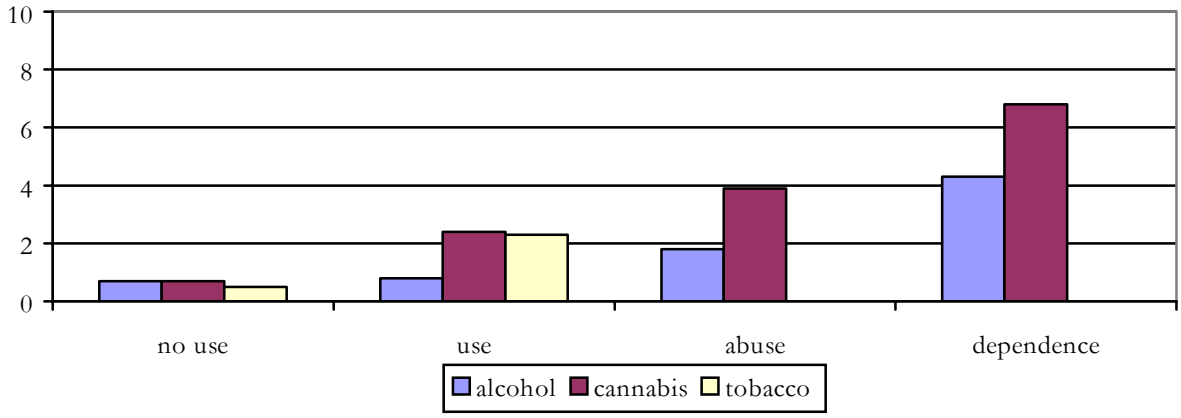
Table 3: Adjusted odds ratios (OR) and 95% confidence intervals (95%CI) of DSM-IV affective and anxiety disorders according to alcohol, tobacco and cannabis use

	Adjusted OR	Adjusted 95%CI
DSM-IV affective disorder		
No alcohol use	1.00	--
Alcohol use	0.98	0.81, 1.19
Alcohol abuse	0.64	0.34, 1.21
Alcohol dependence	1.98	1.45, 2.72
No cannabis use	1.00	--
Cannabis use	1.30	0.94, 1.79
Cannabis abuse	1.46	0.73, 2.90
Cannabis dependence	0.91	0.54, 1.54
No tobacco use	1.00	--
Tobacco use	1.48	1.24, 1.76
DSM-IV anxiety disorder		
No alcohol use	1.00	--
Alcohol use	1.01	0.81, 1.25
Alcohol abuse	0.49	0.23, 1.05
Alcohol dependence	1.85	1.31, 2.62
No cannabis use	1.00	--
Cannabis use	0.87	0.59, 1.27
Cannabis abuse	0.37	0.13, 1.04
Cannabis dependence	1.41	0.84, 2.39
No tobacco use	1.00	--
Tobacco use	1.66	1.36, 2.01

3.4 PSYCHOSIS

Figure 5 shows the association between screening positively on the psychosis screener and alcohol, cannabis and tobacco use (see also Appendix B). As can be seen by the univariate odds ratios, cannabis use of any level, alcohol dependence, and tobacco use were all associated with significantly increased risks of screening positively for psychosis (Table 4). Those meeting criteria for alcohol dependence were 6.4 times more likely than non-drinkers to screen positively, while tobacco users were 4.7 times more likely. Cannabis dependence was associated with an eleven-fold risk of screening positively for psychosis relative to non-users (OR 10.8). Alcohol use and abuse were not associated with increased risks of screening positively for psychosis compared to non-use of alcohol.

Figure 5: Prevalence of persons screening positively for psychosis according to level of involvement with alcohol, cannabis and tobacco



In multiple regression analyses in which these three drug types, and the use of sedatives, stimulants or opiates were considered simultaneously, as well as demographics and neuroticism, only cannabis dependence and tobacco use remained significantly associated with increased odds of screening positively for psychosis (OR 2.8 and 2.5, respectively; Table 4).

Table 4: Adjusted odds ratios (OR) and confidence intervals (95%CI) of screening positively for psychosis according to alcohol, tobacco and cannabis use

	Adjusted OR	Adjusted 95%CI
No alcohol use	1.00	--
Alcohol use	1.22	0.74, 2.01
Alcohol abuse	1.46	0.47, 4.50
Alcohol dependence	1.70	0.87, 3.30
No cannabis use	1.00	--
Cannabis use	1.45	0.77, 2.70
Cannabis abuse	1.76	0.50, 6.17
Cannabis dependence	2.84	1.37, 5.90
No tobacco use	1.00	--
Tobacco use	2.47	1.63, 3.74

4 DISCUSSION

In this study, we have compared the patterns of comorbidity of alcohol, cannabis and tobacco with other drug use, anxiety and affective disorders, and screening positively for psychosis.

Among Australian adults, dependent cannabis use was perhaps the strongest marker (on a univariate level) for other drug use problems. Cannabis abuse and use were also associated with other drug use and drug use problems. In general, significant associations, of similar magnitude, remained between cannabis use, abuse and dependence, and other measures of drug use and drug use problems, after considering a number of other factors – including other drug use variables, demographic variables, and neuroticism.

In comparison, the univariate associations observed between cannabis involvement and mental disorders appeared to be explained largely by other factors, particularly other drug use. While higher rates of anxiety and affective disorders were observed among those reporting cannabis use, abuse and dependence, no significant relationship remained with anxiety or affective disorders after including other measures of drug use (alcohol, tobacco and other drug use). This finding does not exclude the possibility that an indirect causal relationship exists, for example, if cannabis use made the problematic use of other drugs more likely, which in turn increased the risks of depression and anxiety.

Among Australian adults, tobacco smoking was a consistent marker of poorer mental health, in terms of both other drug use and mental health problems. The relationships found in the Australian population between tobacco use, and anxiety and depression, highlight a continued need for effective treatments for persons who wish to stop smoking and who also have mental health problems such as depression, which have been shown to lower the chance of successfully quitting smoking (Anda et al., 1990).

On a univariate level, alcohol abuse and dependence were significantly associated with higher risks of other drug use and use problems. Apart from a significant association with tobacco and cannabis use, alcohol use (without use disorder) was not significantly associated with a higher risk of other drug use, relative to non-users of alcohol. After conducting multivariate analyses, alcohol abuse and dependence remained associated with higher probabilities of other drug use and use disorders.

In contrast, only alcohol dependence was a marker of a higher risk of affective and anxiety disorders. This increased risk remained after controlling for other factors in multiple regressions. Alcohol abuse and alcohol use without use disorder did not appear to be markers of depression or anxiety problems.

The pattern of findings for psychosis was slightly different. All levels of cannabis use were univariately associated with an increased likelihood of screening positively for psychosis using a short screener for psychotic symptoms. Tobacco use was also associated with screening positively, as was alcohol dependence. Alcohol use and abuse were not associated with higher risks of screening positively. After multivariate analyses were conducted, only cannabis dependence and tobacco use remained markers of screening positively for psychosis.

4.1 OTHER DRUG USE

When each drug was considered separately, alcohol, cannabis and tobacco use were all associated with an increased likelihood of using all other drug types considered here. They were also all associated with the *problematic* use of other drug types. In general, alcohol and cannabis abuse/dependence were the strongest markers for other drug use and use disorders.

In almost all cases, this association was not explained by the covariates examined. Table 5 summarises the relationships observed between alcohol, tobacco and cannabis use and other substance use, as well as with the other measures of mental health, after adjustment for demographics and neuroticism. It did not appear to be the case that the higher rates of drug use problems simply reflected demographic differences between groups, or that it reflected the use of multiple drug types. Nevertheless, it must be noted that there are covariates that have not been included in the present analyses, including genetic factors, which may play a role in increasing the likelihood of drug use and problematic drug use.

For more comprehensive discussions of the implications of these findings, see previous reports on each of the three separate drug types (Degenhardt & Hall, 1999; Degenhardt, Hall, & Lynskey, 2000a; Degenhardt, Hall, Teesson, & Lynskey, 2000b).

It is difficult to distinguish between a number of possible explanations for this observed association using this cross-sectional data. The first possibility is that there is no causal relationship between all these indicators of substance use, but that other common factors not considered here are responsible for the association. These might be environmental factors: for example, persons with higher numbers of risk factors such as poor parental relationships have been found to be more likely to use *all* drug types (Lynskey, Fergusson, & Horwood, 1998; Newcomb, Maddahian, & Bentler, 1986). These might also be genetic factors: genetic vulnerabilities have been implicated as increasing the likelihood of alcohol dependence (Kendler et al., 1994; Kendler, Prescott, Neale, & Pedersen, 1997), cannabis dependence (Kendler & Prescott, 1998a), nicotine dependence (Kendler et al., 1999) and cocaine dependence (Kendler & Prescott, 1998b). It is possible that these vulnerabilities may be shared by different drug types, as has been found for nicotine and alcohol dependence (True et al., 1999).

A second possibility is that there is a causal connection between the use of one drug type, and increased likelihood of another. Recent longitudinal evidence, for example, has suggested that even after controlling for a wide range of known risk factors for illicit drug use, cannabis use was still associated with an increased risk of progression to illicit drug use (Fergusson & Horwood, 2000). Nevertheless, much research supports a more general view of substance use as element of a developmental pathway, in which multiple risk factors increase the likelihood of drug use in general, similar to the developmental pathway thought to typify childhood psychopathology (Sroufe, 1997). Early drug use, for example, has been found to increase the likelihood that adolescents will subsequently associate with delinquent peers and move out of home; these factors subsequently increase the likelihood of poor psychosocial outcomes in early adult life (Fergusson & Horwood, 1997). One of these outcomes may be continued or escalated substance use (Newcomb & Bentler, 1988).

Regardless of the reasons for the findings of the present report, however, one thing is clear: tobacco, alcohol and cannabis use are all associated with higher risks of drug use in

general. This finding has implications for the physical and mental health of users. It also has implications for treatment, since it is likely that persons in treatment for one drug type are likely to be problematic users of a range of drug types.

Table 5: Patterns of association between alcohol, tobacco and cannabis use, and other mental health problems after adjusting for demographics and neuroticism

	Alcohol			Tobacco Use	Cannabis		
	U	A	D		U	A	D
Other drug use	X	3	3	X	3	3	3
Other drug use disorders	X	X	3	3	3	X	3
Affective disorders	X	X	3	3	X	X	X
Anxiety disorders	X	X	3	3	X	X	X
Screening positively for psychosis	X	X	X	3	X	X	3

Note: U = use without meeting criteria for DSM-IV abuse or dependence;
A = DSM-IV abuse; and
D = DSM-IV dependence.

4.2 DEPRESSION AND ANXIETY

On a univariate level, cannabis use of all levels was associated with increased rates of anxiety and affective disorders. In contrast, alcohol use was associated with *lower* rates of anxiety and affective disorders, alcohol abuse was not associated with anxiety and affective disorders relative to non-users of alcohol, while alcohol dependence was strongly associated with an increased likelihood of both mental health problems. Tobacco use was also associated with a higher risk of anxiety and affective disorders.

These patterns changed significantly after considering demographics, the use of multiple drug types, and neuroticism. No level of cannabis use was associated with affective or anxiety disorders after these analyses; in particular, it was after including drug use variables together in analyses that cannabis use was no longer significantly associated with anxiety or affective disorders. In contrast, alcohol dependence and tobacco use remained markers for an increased likelihood of anxiety and affective disorders.

There has been recent public concern over the possibility that cannabis use, particularly among young persons, is in some way causally related to depression. The present report found that this relationship did not appear to hold in the Australian adult population. Instead, it seemed to be the fact that cannabis users were more likely to also meet criteria for an alcohol use disorder, smoke tobacco, and use other drug types, and that *these* indicators of other drug use were associated with higher rates of mental health problems. The present findings suggest that it may be more appropriate to direct attention to the use of these other drug types when considering concomitant mental health problems.

However, because the relationship between cannabis use and other drug use did not disappear after controlling for other factors (see section 4.1), there may be an indirect relationship between cannabis use and depression. For example, dependent cannabis users might be more likely to develop other drug use problems as well, and this drug use might then increase the risk of depression. The present data do not allow an

examination of this possibility. Future research might examine this possibility, for example, through longitudinal data. Prospective studies might examine the effect of reducing cannabis and other drug use on depression and anxiety.

4.3 PSYCHOSIS

Alcohol, tobacco and cannabis were all associated with higher chances of screening positively for psychosis, as assessed by a short screening questionnaire for psychotic symptoms. Cannabis dependence appeared to be most strongly associated with screening positively for psychosis on a univariate level. After conducting multivariate analyses, however, only cannabis dependence and tobacco use remained correlated with screening positively for psychosis. The strength of the association was similar for both tobacco use and cannabis dependence (odds ratios of 2.5 and 2.8, respectively).

The association between cannabis and tobacco use and mental health needs to be disseminated to persons at risk of psychotic illness, to persons who have already been diagnosed with a psychotic illness, and to persons who are heavy substance users. The risks of exacerbation of, or relapse to mental health problems, also need to be highlighted.

More attention also needs to be given to the *physical* health risks of heavy or problematic substance use. The high rate of tobacco smoking among persons who screened positively for psychosis means they are at greater risk of tobacco-related diseases such as lung cancer (US Surgeon General, 1982). This risk may be particularly high since there is some evidence to suggest that persons with psychosis smoke more heavily and use higher tar cigarettes (Masterson & O'Shea, 1984), which would increase smoking-related harms. Nicotine substitution may be one way in which these harms could be reduced among this population, as well as interventions aimed at abstinence. Future research could evaluate the feasibility of such interventions.

Heavy or long-term cannabis smokers may also face physical health risks (Hall & Solowij, 1998; Hall, Solowij, & Lemon, 1994). For example, recent evidence suggests that cannabis smokers may face an increased risk of mouth and throat cancers (Zhang et al., 1999). These risks need to be communicated to cannabis users.

4.4 CONCLUSIONS

In this general population sample, the strongest markers of other drug use were alcohol dependence and any involvement with cannabis use, with cannabis dependence being the strongest marker overall. Cannabis dependence was also the strongest marker of meeting criteria for another drug use disorder. In contrast, the strongest marker of anxiety and affective disorders was alcohol dependence. These findings did not appear to be explained by a number of other factors considered here. Tobacco smoking was a consistent marker of poorer mental health, remaining associated with higher rates of affective and anxiety disorders, substance use disorders, and screening positively for psychosis.

These findings suggest that different drug types are differentially associated with a range of other mental health problems. These differential risks need to be taken into account in treatment. Further research is required to examine these findings.

5 REFERENCES

American Psychiatric Association. (1952). *Diagnostic and Statistical Manual of Mental Disorders (First Edition)*. Washington: American Psychiatric Association.

American Psychiatric Association. (1968). *Diagnostic and Statistical Manual of Mental Disorders (Second Edition)*. Washington: American Psychiatric Association.

American Psychiatric Association. (1980). *Diagnostic and Statistical Manual of Mental Disorders (Third Edition)*. Washington: American Psychiatric Association.

American Psychiatric Association. (1987). *Diagnostic and Statistical Manual of Mental Disorders (Third Edition - Revised)*. Washington, DC: American Psychiatric Association.

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition)*. Washington, DC: American Psychiatric Association.

Anda, R., Williamson, D., Escobedo, L., Mast, E., Giovino, G., & Remington, P. (1990). Depression and the dynamics of smoking. *Journal of the American Medical Association, 264*(12), 1541-1545.

Andrews, G., & Peters, L. (1998). The psychometric properties of the Composite International Diagnostic Interview. *Social Psychiatry & Psychiatric Epidemiology, 33*(2), 80-8.

Angold, A., Costello, E. J., & Erkanli, A. (1999). Comorbidity. *Journal of Child Psychology and Psychiatry, 40*(1), 57-87.

Anthony, J. C., & Helzer, J. (1991). Syndromes of drug abuse and dependence. In L. N. Robins & D. A. Regier (Eds.), *Psychiatric Disorders in America* (pp. 116-154). New York: The Free Press.

Anthony, J. C., Warner, L., & Kessler, R. (1994). Comparative epidemiology of dependence on tobacco, alcohol, controlled substances, and inhalants: Basic findings from the National Comorbidity Survey. *Experimental and Clinical Psychopharmacology, 2*(3), 244-268.

Ashley, M. J., Ferrence, R., Room, R., Bondy, S., Rehm, J., & Single, E. (1997). Moderate drinking and health. Implications of recent evidence [see comments]. *Canadian Family Physician, 43*, 687-94.

Australian Institute of Health and Welfare. (1999). *1998 National Drug Strategy Household Survey: First results* . Canberra: Australian Institute of Health (Drug Statistics Series).

Bachman, J., & Jones, R. T. (1979). Personality correlates of cannabis dependence. *Addictive Behaviors, 4*(4), 361-371.

Barbee, J. G., Clark, P. D., Crapanzo, M. S., Heintz, G. C., & Kehoe, C. E. (1989). Alcohol and substance abuse among schizophrenic patients presenting to an emergency psychiatry service. *Journal of Nervous and Mental Disease, 177*, 400-417.

Berkson, J. (1946). Limitations of the application of fourfold table analysis to hospital data. *Biometrics Bulletin, 2*, 47-53.

Bijl, R. V., Ravelli, A., & van Zessen, G. (1998). Prevalence of psychiatric disorder in the general population: Results of the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Social Psychiatry and Psychiatric Epidemiology, 33*(12), 587-595.

Bland, R., Newman, S., & Orn, H. (1988). Epidemiology of psychiatric disorders in Edmonton, Canada. *Acta Psychiatrica Scandinavica, 77*(supp 376), 1-80.

Blazer, D., Hughes, D., George, L., Swartz, M., & Boyer, R. (1991). Generalized anxiety disorder. In L. Robins & D. Regier (Eds.), *Psychiatric Disorders in America* . New York: MacMillan.

Boyd, J. H., Burke, J. D., Gruenberg, E., & al., e. (1984). Exclusion criteria of DSM-III: A study of co-occurrence of hierarchy-free syndromes. *Archives of General Psychiatry, 41*, 983-989.

Brady, K. T., Casto, S., Lydiard, R. B., Malcolm, R., & et al. (1991). Substance abuse in an inpatient psychiatric sample. *American Journal of Drug & Alcohol Abuse, 17*(4), 389-397.

Breslau, N. (1995). Psychiatric comorbidity of smoking and nicotine dependence. *Behavior Genetics, 25*(2), 95-101.

Breslau, N., Kilbey, M., & Andreski, P. (1991). Nicotine dependence, major depression, and anxiety in young adults. *Archives of General Psychiatry, 48*(12), 1069-74.

Breslau, N., Kilbey, M. M., & Andreski, P. (1993). Vulnerability to psychopathology in nicotine-dependent smokers: An epidemiologic study of young adults. *American Journal of Psychiatry, 150*(6), 941-946.

Breslau, N., Kilbey, M. M., & Andreski, P. (1994). DSM-III--R nicotine dependence in young adults: Prevalence, correlates and associated psychiatric disorders. *Addiction, 89*(6), 743-754.

Brown, S., & Schuckit, M. (1988). Changes in depression amongst abstinent alcoholics. *Journal of Studies in Alcohol, 52*, 37-43.

Cantor, C., Neulinger, K., & De Leo, D. (1999). Australian suicide trends 1964-1997: Youth and beyond? *Medical Journal of Australia, 171*, 137-141.

Cappell, H., & Greeley, J. (1987). Alcohol and tension reduction: An update on research and theory. In H. T. Blane & K. E. Leonard (Eds.), *Psychological theories of drinking and alcoholism* (pp. 15-54). London: Guilford Press.

Caron, C., & Rutter, M. (1991). Comorbidity in child psychopathology: Concepts, issues and research strategies. *Journal of Child Psychology and Psychiatry, 32*(2), 1063-1080.

Chick, J. (1999). Can light or moderate drinking benefit mental health? *European Addiction Research, 5*, 74-81.

Chyou, P. H., Burchfiel, C. M., Yano, K., Sharp, D. S., Rodriguez, B. L., Curb, J. D., & Nomura, A. M. (1997). Obesity, alcohol consumption, smoking, and mortality. *Annals of Epidemiology, 7*(4), 311-7.

Cohen, M., & Klein, D. F. (1970). Drug abuse in a young psychiatric population. *American Journal of Orthopsychiatry, 40*, 448-455.

Cottler, L. B., Robins, L. N., Grant, B. F., Blaine, J., Towle, L. H., Wittchen, H. U., & Sartorius, N. (1991). The CIDI-core substance abuse and dependence questions: cross-cultural and nosological issues. The WHO/ADAMHA Field Trial. *British Journal of Psychiatry, 159*, 653-8.

Covey, L. S. (1999). Tobacco cessation among patients with depression. *Primary Care, 26*(3), 691-.

Crum, R. M., Bucholz, K. K., Helzer, J. E., & Anthony, J. C. (1992). The risk of alcohol abuse and dependence in adulthood: the association with educational level. *American Journal of Epidemiology, 135*(9), 989-99.

Crum, R. M., Helzer, J. E., & Anthony, J. C. (1993). Level of education and alcohol abuse and dependence in adulthood: a further inquiry. *American Journal of Public Health, 83*(6), 830-7.

Dalack, G. W., Healy, D. J., & Meador-Woodruff, J. H. (1998). Nicotine dependence in schizophrenia: clinical phenomena and laboratory findings. *American Journal of Psychiatry, 155*(11), 1490-501.

Degenhardt, L., & Hall, W. (1999). *The relationship between tobacco use, substance use disorders and mental disorders: Results from the National Survey of Mental Health and Well-Being* (Technical Report 80). Sydney: National Drug and Alcohol Research Centre, University of NSW.

Degenhardt, L., Hall, W., & Lynskey, M. (2000a). *Cannabis use and mental health among Australian adults: Findings form the National Survey of Mental Health and Well-Being* (Technical Report 98). Sydney: National Drug and Alcohol Research Centre, UNSW.

Degenhardt, L., Hall, W., Teesson, M., & Lynskey, M. (2000b). *Alcohol use disorders in Australia: Findings from the National Survey of Mental Health and Well-Being* (Technical Report 97). Sydney: National Drug and Alcohol Research Centre, UNSW.

DiFranza, J. R., & Guerrera, M. P. (1990). Alcoholism and smoking. *Journal of Studies on Alcohol, 51*(2), 130-134.

Diwan, A., Castine, M., Pomerleau, C. S., Meador-Woodruff, J. H., & Dalack, G. W. (1998). Differential prevalence of cigarette smoking in patients with schizophrenic vs mood disorders. *Schizophrenia Research, 33*(1-2), 113-8.

Dixon, L., Haas, G., Weiden, P., Sweeney, J., & Frances, A. (1991). Drug abuse in schizophrenic patients: Clinical correlates and reasons for use. *American Journal of Psychiatry, 148*(2), 224-230.

Donnelly, N., & Hall, W. (1994). *Patterns of cannabis use in Australia. NCADA Monograph Sries No. 27* . Canberra: Australian Government Publishing Service.

Dooley, D., Catalano, R., & Wilson, G. (1994). Depression and unemployment: Panel findings fom the Epidemiological Catchment Area study. *American Journal of Community Psychology, 22*(6), 745-765.

Drake, R., Osher, F., & Wallach, M. (1989). Alcohol use and abuse in schizophrenia. *Journal of Nervous and Mental Disease, 177*(7), 408-414.

Drake, R., & Wallach, M. (1989). Substance abuse among the chronically mentally ill. *Hospital and Community Psychiatry, 40*(10), 1041-1046.

Edwards, G., & Gross, M. (1976). Alcohol dependence: provisional description of a clinical syndrome. *British Medical Journal, 1*, 1058-1061.

Edwards, G., Gross, M., Keller, M., Moser, J., & Room, R. (1977). *Alcohol-related disabilities* . Geneva: World Health Organization.

Eysenck, H. J. (1963). Personality and cigarette smoking. *Life Sciences, 3*, 777-792.

Eysenck, H. J., & Eysenck, S. B. G. (1991). *Manual of the Eysenck Personality Scales (EPS Adult)*. London: Hodder & Stoughton.

Farmer, A., Katz, R., McGuffin, P., & Bebbington, P. (1987). A comparison between the Present State Examination and the Composite International Diagnostic Interview. *Archives of General Psychiatry, 44*, 1064-1068.

Farrell, M., Howes, S., Taylor, C., Lewis, G., Jenkins, R., Bebbington, P., Jarvis, M., Brugha, T., Gill, B., & Meltzer, H. (1998). Substance misuse and psychiatric comorbidity: An overview of the OPCS National Psychiatric Morbidity Survey. *Addictive Behaviors, 32*(6), 909-918.

Feinstein, A. R. (1970). The pre-therapeutic classification of comorbidity in chronic disease. *Journal of Chronic Diseases, 23*, 455-468.

Fergusson, D. M., & Horwood, L. J. (1997). Early onset cannabis use and psychosocial adjustment in young adults. *Addiction, 92*(3), 279-296.

Fergusson, D. M., & Horwood, L. J. (2000). Does cannabis use encourage other forms of illicit drug use? *Addiction, 95*(4), 505-520.

Fillmore, K. M., Golding, J. M., Graves, K. L., Kniep, S., Leino, E. V., Romelsjo, A., Shoemaker, C., Ager, C. R., Allebeck, P., & Ferrer, H. P. (1998). Alcohol consumption and mortality. I. Characteristics of drinking groups. *Addiction, 93*(2), 183-203.

Fischer, E. H., & Goethe, J. W. (1998). Anxiety and alcohol abuse in patients in treatment for depression. *American Journal of Drug and Alcohol Abuse, 24*(3), 453-463.

Forthofer, M. S., Kessler, R. C., Story, A. L., & Gotlib, I. H. (1996). The effects of psychiatric disorders on the probability and timing of first marriage. *Journal of Health & Social Behavior, 37*(2), 121-32.

Fowler, I., Carr, V., Carter, N., & Lewin, T. (1998). Patterns of current and lifetime substance use in schizophrenia. *Schizophrenia Bulletin, 24*(3), 443-455.

Galbaud Du Fort, G., Newman, S., & Bland, R. (1993). Psychiatric comorbidity and treatment seeking: Sources of selection bias in the study of clinical populations. *Journal of Nervous and Mental Disease, 181*(8), 464-474.

Gilbert, D. G., & Gilbert, B. O. (1995). Personality, psychopathology and nicotine response as mediators of the genetics of smoking. *Behavior Genetics, 25*(2), 133-147.

Giovino, G., Henningfield, J., Tomar, S., Escobedo, L., & Slade, J. (1995). Epidemiology of tobacco use and dependence. *Epidemiologic Reviews, 17*(1), 48-65.

Glass, R. (1990). Blue mood, blackened lungs: Depression and smoking. *Journal of the American Medical Association, 264*(12), 1583-1584.

Glassman, A. H. (1993). Cigarette smoking: Implications for psychiatric illness. *American Journal of Psychiatry, 150*(4), 546-553.

Glassman, A. H. (1998). Psychiatry and Cigarettes. *Archives of General Psychiatry, 55*(8), 692-693.

Glassman, A. H., Helzer, A., & Covey, L. (1990). Smoking, smoking cessation, and major depression. *Journal of the American Medical Association, 264*, 1546-1549.

Goff, D. C., Henderson, D. C., & Amico, E. (1992). Cigarette smoking in schizophrenia: relationship to psychopathology and medication side effects. *American Journal of Psychiatry, 149*, 1189-1194.

Golding, J. F., Harpur, T., & Brent-Smith, H. (1983). Personality, drinking and drug-taking correlates of cigarette smoking. *Personality and Individual Differences, 4*(6), 703-706.

Grant, B. F. (1995). Comorbidity between DSM-IV drug use disorders and major depression: results of a national survey of adults. *Journal of Substance Abuse, 7*(4), 481-97.

Grant, B. F., Hasin, D. S., & Dawson, D. A. (1996). The relationship between DSM-IV alcohol use disorders and DSM-IV major depression: examination of the primary-secondary distinction in a general population sample. *Journal of Affective Disorders, 38*(2-3), 113-28.

Grant, B. F., & Pickering, R. (1998). The relationship between cannabis use and DSM-IV cannabis abuse and dependence: Results from the national longitudinal alcohol epidemiologic survey. *Journal of Substance Abuse, 10*(3), 255-264.

Green, B. E., & Ritter, C. (2000). Marijuana use and depression. *Journal of Health and Social Behavior, 41*(1), 40-49.

Greenfield, S. F., & O'Leary, G. (1999). Sex differences in marijuana use in the United States. *Harvard Review of Psychiatry, 6*(6), 297-303.

Gruber, A. J., Pope, H. G., & Oliva, P. (1997). Very long-term users of marijuana in the United States: A pilot study. *Substance Use and Misuse, 32*(3), 249-264.

Guimaraes, F. S., Chiaretti, T. M., Graeff, F. G., & Zuardi, A. W. (1990). Antianxiety effect of cannabidiol in the elevated plus-maze. *Psychopharmacology, 100*(4), 558-559.

Haines, A. P., Imeson, J. D., & Meade, T. W. (1980). Psychoneurotic profiles of smokers and nonsmokers. *British Medical Journal, 280*, 1422.

Hall, W. (1998). Cannabis use and psychosis. *Drug and Alcohol Review, 17*, 433-444.

Hall, W., Johnston, L., & Donnelly, N. (1999). Epidemiology of cannabis use and its consequences. In H. Kalant, W. Corrigall, W. Hall, & R. Smart (Eds.), *The health effects of cannabis* (pp. 71-125). Toronto: Canada: Centre for Addiction and Mental Health.

Hall, W., & Solowij, N. (1998). Adverse Effects of Cannabis. *Lancet, 352*(9140), 1611-1616.

Hall, W., Solowij, N., & Lemon, J. (1994). *The health and psychological consequences of cannabis use* (National Drug Strategy Monograph No.25). Canberra: Australian Publishing Service.

Hanna, E. Z., Chou, S. P., & Grant, B. F. (1997). The relationship between drinking and heart disease morbidity in the United States: results from the National Health Interview Survey. *Alcoholism, Clinical & Experimental Research, 21*(1), 111-8.

Hasin, D. S., & Glick, H. (1993). Depressive symptoms and DSM-III-R alcohol dependence: general population results. *Addiction, 88*(10), 1431-6.

Hays, L. R., Farabee, D., & Miller, W. (1998). Caffeine and nicotine use in an addicted population. *Journal of Addictive Diseases, 17*(1), 47-54.

Heath, A. C., Madden, P., Slutske, W., & Martin, N. (1995). Personality and the inheritance of smoking behavior: A genetic perspective. *Behavior Genetics, 25*(2), 103-117.

Helzer, J., Burnam, A., & McEvoy, L. (1991). Alcohol abuse and dependence. In L. N. Robins & D. A. Regier (Eds.), *Psychiatric disorders in America* (pp. 81-115). New York: The Free Press.

Henderson, A. S., Jorm, A. F., Korten, A. E., Jacomb, P., Christensen, H., & Rodgers, B. (1998). Symptoms of depression and anxiety during adult life: Evidence for a decline in prevalence with age. *Psychological Medicine, 28*(6), 1321-1328.

Henningfield, J., Clayton, R., & Pollin, W. (1990). Involvement of tobacco in alcoholism and illicit drug use. *British Journal of Addiction, 85*, 279-292.

Himle, J., Abelson, J., Haghightgou, H., Hill, E., Nesse, R., & Curtis, G. (1999). Effect of alcohol on social phobic anxiety. *American Journal of Psychiatry, 156*(8), 1237-1243.

Hughes, J., Hatsukami, D., Mitchell, J., & Dahlgren, L. (1986). Prevalence of smoking among psychiatric outpatients. *American Journal of Psychiatry, 143*(8), 993-997.

Jablensky, A., McGrath, J., Herrman, H., Castle, D., Gureje, O., Evans, M., Carr, V., Mrogan, V., Korten, A., & Harvey, C. (2000). Psychotic disorders in urban areas: an overview of the Study on Low Prevalence disorders. *Australian and New Zealand Journal of Psychiatry, 43*, 221-236.

Janca, A., Robins, L., Cottler, L., & Early, T. (1992). Clinical observation of assessment using the Composite International Diagnostic Interview (CIDI): an analysis of the CIDI field trials - wave II at the St Louis site. *British Journal of Psychiatry, 160*, 815-818.

Kandel, D., Chen, K., Warner, L. A., Kessler, R. C., & Grant, B. (1997). Prevalence and demographic correlates of symptoms of last year dependence on alcohol, nicotine, marijuana and cocaine in the U.S. population. *Drug & Alcohol Dependence, 44*(1), 11-29.

Kandel, D., & Faust, R. (1975). Sequence and stages in patterns of adolescent drug use. *Archives of General Psychiatry, 32*, 923-932.

Kandel, D. B. (1984). Marijuana users in young adulthood. *Archives of General Psychiatry, 41*, 200-209.

Kandel, D. B., Davies, M., Karus, D., & Yamaguchi, K. (1986). The consequences in young adulthood of adolescent drug involvement. *Archives of General Psychiatry, 43*, 746-754.

Keil, U., Chambless, L. E., Doring, A., Filipiak, B., & Stieber, J. (1997). The relation of alcohol intake to coronary heart disease and all-cause mortality in a beer-drinking population [see comments]. *Epidemiology, 8*(2), 150-6.

Kendler, K., Neale, M., MacLean, C., Heath, A., Eaves, L., & Kessler, R. (1993a). Smoking and major depression: A causal analysis. *Archives of General Psychiatry, 50*(1), 36-43.

Kendler, K., Neale, M., Sullivan, P., Corey, L., Gardner, C., & Prescott, C. (1999). A population-based twin study in women of smoking initiation and nicotine dependence. *Psychological Medicine, 29*(2), 299-308.

Kendler, K. S., Heath, A. C., Neale, M. C., Kessler, R. C., & Eaves, L. J. (1992a). A population-based twin study of alcoholism in women. *JAMA, 268*(14), 1877-82.

Kendler, K. S., Heath, A. C., Neale, M. C., Kessler, R. C., & Eaves, L. J. (1993b). Alcoholism and major depression in women. A twin study of the causes of comorbidity. *Archives of General Psychiatry, 50*(9), 690-8.

Kendler, K. S., Neale, M., Kessler, R. C., Heath, A. C., & Eaves, L. J. (1992b). Major depression and generalized anxiety disorder: Same genes, (partly) different environments? *Archives of General Psychiatry, 49*, 716-722.

Kendler, K. S., Neale, M. C., Heath, A. C., Kessler, R. C., & Eaves, L. J. (1994). A twin-family study of alcoholism in women. *American Journal of Psychiatry, 151*(5), 707-15.

Kendler, K. S., & Prescott, C. A. (1998a). Cannabis use, abuse, and dependence in a population-based sample of female twins. *American Journal of Psychiatry, 155*(8), 1016-22.

Kendler, K. S., & Prescott, C. A. (1998b). Cocaine use, abuse and dependence in a population-based sample of female twins. *British Journal of Psychiatry, 173*, 345-50.

Kendler, K. S., Prescott, C. A., Neale, M. C., & Pedersen, N. L. (1997). Temperance board registration for alcohol abuse in a national sample of Swedish male twins, born 1902 to 1949. *Archives of General Psychiatry, 54*(2), 178-84.

Kendler, K. S., Walters, E. E., Neale, M. C., Kessler, R. C., Heath, A. C., & Eaves, L. J. (1995). The structure of the genetic and environmental risk factors for six major psychiatric disorders in women. Phobia, generalized anxiety disorder, panic disorder, bulimia, major depression, and alcoholism. *Archives of General Psychiatry, 52*(5), 374-83.

Kessler, R., Nelseon, B., McGonagle, K., Liu, J., Swartz, M., & Blazer, D. (1996). Comorbidity of DSM-III-R major depressive disorder in the general population: Results from the US National Comorbidity Survey. *British Journal of Psychiatry, 168*(suppl 30), 17-30.

Kessler, R. C. (1995). Epidemiology of psychiatric comorbidity. In M. T. Tsuang, M. Tohen, & G. E. P. Zahner (Eds.), *Textbook in Psychiatric Epidemiology* (pp. 179-197). New York: Wiley and Sons.

Kessler, R. C., Crum, R. M., Warner, L. A., Nelson, C. B., Schulenberg, J., & Anthony, J. C. (1997). Lifetime co-occurrence of DSM-III-R alcohol abuse and dependence

with other psychiatric disorders in the National Comorbidity Survey. *Archives of General Psychiatry, 54*(4), 313-21.

Kessler, R. C., Foster, C. L., Saunders, W. B., & Stang, P. E. (1995). Social consequences of psychiatric disorders, I: Educational attainment. *American Journal of Psychiatry, 152*(7), 1026-32.

Kessler, R. C., Walters, E. E., & Forthofer, M. S. (1998). The social consequences of psychiatric disorders, III: probability of marital stability. *American Journal of Psychiatry, 155*(8), 1092-6.

Klerman, G. L. (1990). Approaches to the phenomena of comorbidity. In J. Maser & C. Cloninger (Eds.), *Comorbidity of mood and anxiety disorders* (pp. 13-40). Washington: APP.

Koob, G. F., & LeMoal, M. (1997). Drug abuse: Hedonic homeostatic dysregulation. *Science, 278*, 52-58.

Krishnan-Sarin, S., Rosen, M., & O'Malley, S. (1999). Preliminary Evidence of an Opioid Component in Nicotine Dependence. *Archives of General Psychiatry, 56*, 663-668.

Kushner, M. G., Sher, K. J., & Erickson, D. J. (1999). Prospective analysis of the relation between DSM-III anxiety disorders and alcohol use disorders. *American Journal of Psychiatry, 156*(5), 723-32.

Lambert, M., Haasen, C., Mass, R., & Krausz, M. (1997). [Consumption patterns and motivation for use of addictive drugs in schizophrenic patients]. *Psychiatrische Praxis, 24*(4), 185-9.

Lynskey, M., Degenhardt, L., & Hall, W. (2000). Cohort trends in youth suicide in Australia 1964 to 1997. *Australian and New Zealand Journal of Psychiatry, 34*, 408-412.

Lynskey, M., & Hall, W. (2000). The effects of adolescent cannabis use on educational attainment: A review. *Addiction, 95*(11), 1621-1630.

Lynskey, M. T., Fergusson, D. M., & Horwood, L. J. (1998). The origins of the correlations between tobacco, alcohol, and cannabis use during adolescence. *Journal of Child Psychology and Psychiatry, 39*(7), 995-1005.

Makkai, T., & McAllister, I. (1998). *Patterns of drug use in Australia, 1985-1995*. Canberra: Australian Government Publishing Service.

Marks, J. L., Hill, E. M., Pomerleau, C. S., Mudd, S. A., & Blow, F. C. (1997). Nicotine dependence and withdrawal in alcoholic and nonalcoholic ever-smokers. *Journal of Substance Abuse Treatment, 14*(6), 521-7.

Martin, N. (1985). Neuroticism as predisposition toward depression: A cognitive mechanism. *Personality and Individual Differences, 6*, 353-365.

Masterson, F., & O'Shea, B. (1984). Smoking and malignancy in schizophrenia. *British Journal of Psychiatry, 145*, 429-432.

McEvoy, J., & Brown, S. (1999). Smoking in first-episode patients with schizophrenia. *American Journal of Psychiatry, 156*, 1120A-1121.

Merikangas, K. R., Angst, J., Eaton, W., Canino, G., Rubio-Stipec, M., Wacker, H., Wittchen, H. U., Andrade, L., Essau, C., Whitaker, A., Kraemer, H., Robins, L. N., & Kupfer, D. J. (1996). Comorbidity and boundaries of affective disorders with anxiety disorders and substance misuse: results of an international task force. *British Journal of Psychiatry - Supplement*(30), 58-67.

Milich, R., Lynam, D., Zimmerman, R., Logan, T., Martin, C., Leukefield, C., Portis, C., Miller, J., & Clayton, R. (2000). Differences in young adult psychopathology among drug abstainers, experimenters, and frequent users. *Journal of Substance Abuse, 11*(1), 69-88.

Miller, N. S., Klamen, D., Hoffmann, N. G., & Flaherty, J. A. (1996). Prevalence of depression and alcohol and other drug dependence in addictions treatment populations. *Journal of Psychoactive Drugs, 28*(2), 111-124.

Modestin, J., Nussbaumer, C., Angst, K., Scheidegger, P., & Hell, D. (1997). Use of potentially abusive psychotropic substances in psychiatric inpatients. *European Archives of Psychiatry & Clinical Neuroscience, 247*(3), 146-53.

Mueller, T. I., Lavori, P. W., Keller, M. B., Swartz, A., Warshaw, M., Hasin, D., Coryell, W., Endicott, J., Rice, J., & Akiskal, H. (1994). Prognostic effect of the variable course of alcoholism on the 10-year course of depression. *American Journal of Psychiatry, 151*(5), 701-6.

Mueser, K. T., Rosenberg, S. D., Drake, R. E., Miles, K. M., Wolford, G., Vidaver, R., & Carrieri, K. (1999). Conduct disorder, antisocial personality disorder and substance use disorders in schizophrenia and major affective disorders. *Journal of Studies on Alcohol, 60*(2), 278-84.

Mueser, K. T., Yarnold, P. R., Rosenberg, S. D., Swett, C., Miles, K. M., & Hill, D. (2000). Substance use disorder in hospitalized severely mentally ill psychiatric patients: Prevalence, correlates, and subgroups. *Schizophrenia Bulletin, 26*(1), 179-192.

Newcomb, M. D., & Bentler, P. (1988). *Consequences of adolescent drug use*. California: Sage Publications.

Newcomb, M. D., Maddahian, E., & Bentler, P. M. (1986). Risk factors for drug use among adolescents: Concurrent and longitudinal analyses. *American Journal of Public Health, 76*(5), 525-531.

Nutt, D. (1997). The neurochemistry of addiction. *Human Psychopharmacology, 12*, s53-s58.

O'Farrell, T. J., Connors, G. J., & Upper, D. (1983). Addictive behaviors among hospitalised psychiatric patients. *Addictive Behaviors, 8*, 329-333.

Ogden, M. E., Dundas, M., & Bhat, A. V. (1989). Personality differences among alcohol misusers in community treatment. *Personality and Individual Differences, 10*(2), 265-267.

Patton, G. C., Carlin, J. B., Coffey, C., Wolfe, R., Hibbert, M., & Bowes, G. (1998). Depression, anxiety and smoking initiation: A prospective study over three years. *American Journal of Public Health, 88*(10), 1518-1522.

Peters, L., Clarke, D., & Carroll, F. (1999). Are computerised interviews equivalent to human interviewers? CIDI-Auto versus CIDI in Anxiety and Depressive Disorders. *Psychological Medicine, 28*, 893-901.

Poikolainen, K., & Vartiainen, E. (1999). Wine and good subjective health. *American Journal of Epidemiology, 150*, 47-50.

Pomerleau, C. S. (1997). Co-factors for smoking and evolutionary psychobiology. *Addiction, 92*(4), 397-408.

Power, C., Rodgers, B., & Hope, S. (1998). U-shaped relation for alcohol consumption and health in early adulthood and implications for mortality [letter]. *Lancet, 352*(9131), 877.

Pozzi, G., Bacigalupi, M., & Tempesta, E. (1997). Comorbidity of drug dependence and other mental disorders: a two-phase study of prevalence at outpatient treatment centres in Italy. *Drug & Alcohol Dependence, 46*(1-2), 69-77.

Prescott, C. A., Neale, M. C., Corey, L. A., & Kendler, K. S. (1997). Predictors of problem drinking and alcohol dependence in a population-based sample of female twins. *Journal of Studies on Alcohol, 58*(2), 167-81.

Rankin, H., Stockwell, T., & Hodgson, R. (1982). Personality and alcohol dependence. *Personality and Individual Differences, 3*(2), 145-151.

Renaud, S. C., Gueguen, R., Schenker, J., & d'Houtaud, A. (1998). Alcohol and mortality in middle-aged men from eastern France. *Epidemiology, 9*(2), 184-8.

Research Triangle Institute. (1997). SUDAAN Version 7.5.3 (Version 7.5.3). Research Triangle Park: Research Triangle Institute.

Rimm, E., Klatsky, A., Grobbee, D., & Stampfer, M. (1996). Review of moderate alcohol consumption and reduced risk of coronoary heart disease: is the effects due to beer, wine or spirits? *British Medical Journal, 312*, 731-736.

Rimm, E., Williams, P., Fosher, K., Criqui, M., & Stampfer, M. (1999). Moderate alcohol intake and lower risk of coronary heart disease: Meta-analysis of effects on lipids and haemostatic factors. *British Medical Journal, 319*, 1523-1528.

Roberts, R. S., Spitzer, W. O., Delmore, T., & Sackett, D. L. (1978). An empirical demonstration of Berkson's bias. *Journal of Chronic Diseases, 31*, 119-128.

Robins, L. N., & Regier, D. A. (Eds.). (1991). *Psychiatric disorders in America: The Epidemiological Catchment Area study*. New York: The Free Press.

Ross, H. (1995). DSM-III-R alcohol abuse and dependence and psychiatric comorbidity in Ontario: results from the Mental Health Supplement to the Ontario Health Survey. *Drug and Alcohol Dependence, 39*, 111-128.

Sacco, R., Elkind, M., Boden-Albala, B., Lin, I.-F., Kargman, D. E., Hauser, W. A., Shea, S., & Paik, M. (1999). The protective effect of moderate alcohol consumption on ischemic stroke. *Journal of the American Medical Association, 281*(1), 53-60.

Schuckit, M., Tipp, J., Bergman, M., Reich, W., Hesselbrock, V., & Smith, T. (1997a). Comparison of induced and independent major depressive disorders in 2945 alcoholics. *American Journal of Psychiatry, 154*, 948-957.

Schuckit, M., Tipp, J., Bucholz, K., Nurnberger, J., Hesselbrock, V., Crowe, R., & Kramer, J. (1997b). The life-time rates of three major mood disorders and four major anxiety disorders in alcoholics and controls. *Addiction, 92*, 1289-1304.

Sethi, B. B., Trivedi, J. K., Kumar, P., Gulati, A., Agarwal, A. K., & Sethi, N. (1986). Antianxiety effect of cannabis: involvement of central benzodiazepine receptors. *Biological Psychiatry, 21*(1), 3-10.

Shedler, J., & Block, J. (1990). Adolescent drug use and psychological health: A longitudinal inquiry. *American Psychologist, 45*(5), 612-630.

Sieber, M. F. (1981). Personality scores and licit and illicit substance use. *Personality and Individual Differences, 2*(3), 235-241.

Sieber, M. F., & Angst, J. (1990). Alcohol, tobacco and cannabis: 12-year longitudinal associations with antecedent social context and personality. *Drug and Alcohol Dependence, 25*(3), 281-292.

Spielberger, C. D., & Jacobs, G. A. (1982). Personality and smoking behavior. *Journal of Personality Assessment, 46*, 396-403.

Sroufe, L. A. (1997). Psychopathology as an outcome of development. *Development and Psychopathology, 9*, 251-268.

STATA Corporation. (1997). Intercooled STATA for Windows 5.0. Texas: STATA Corporation.

Szuster, R. R., Pontius, E. B., & Campos, P. E. (1988). Marijuana sensitivity and panic anxiety. *Journal of Clinical Psychiatry, 49*(11), 427-429.

Tambs, K., Harris, J. R., & Magnus, P. (1997). Genetic and environmental contributions to the correlation between alcohol consumption and symptoms of anxiety and depression: Results from a bivariate analysis of Norwegian twin data. *Behavior Genetics, 27*(3), 241-250.

Thomas, H. (1993). Psychiatric symptoms in cannabis users [see comments]. *British Journal of Psychiatry, 163*, 141-9.

Thun, M. J., Peto, R., Lopez, A. D., & al., e. (1997). Alcohol consumption and mortality among middle-aged and elderly US adults. *New England Journal of Medicine, 337*, 1704-1714.

Tien, A. Y., & Anthony, J. C. (1990). Epidemiological analysis of alcohol and drug use as risk factors for psychotic experiences. *Journal of Nervous & Mental Disease, 178*(8), 473-80.

Tomasson, K., & Vaglum, P. (1995). A nationwide representative sample of treatment-seeking alcoholics: a study of psychiatric comorbidity. *Acta Psychiatrica Scandinavica, 92*(5), 378-85.

Tomasson, K., & Vaglum, P. (1998). The role of psychiatric comorbidity in the prediction of readmission for detoxification. *Comprehensive Psychiatry, 39*(3), 129-36.

Troisi, A., Pasini, A., Saracco, M., & Spalletta, G. (1998). Psychiatric symptoms in male cannabis users not using other illicit drugs. *Addiction, 93*(4), 487-492.

True, W., Xian, H., Scherrer, J., Madden, P., Bucholz, K., Heath, A., Eisen, S., Lyons, M., Goldberg, J., & Tsuang, M. (1999). Common genentic vulnerability for nicotine and alcohol dependence. *Archives of General Psychiatry, 56*, 655-661.

Tucker, P., & Westermeyer, J. (1995). Substance abuse in patients with comorbid anxiety disorder: A comparative study. *American Journal on Addictions, 4*(3), 226-233.

US Surgeon General. (1982). *The health consequences of smoking. Cancer* . Rockville: US Department of Health and Human Services.

Volk, R. J., Cantor, S. B., Steinbauer, J. R., & Cass, A. R. (1997). Alcohol use disorders, consumption patterns, and health-related quality of life of primary care patients. *Alcoholism, Clinical & Experimental Research, 21*(5), 899-905.

Weil, A. (1970). Adverse reactions to marihuana. *New England Journal of Medicine, 282*, 997-1000.

Wells, B., & Stacey, B. (1976). A further comparison of cannabis (marijuana) users and non-users. *British Journal of Addiction, 71*(2), 161-165.

Wheatley, M. (1998). The prevalence and relevance of substance use in detained schizophrenic patients. *Journal of Forensic Psychiatry, 9*(1), 114-129.

Windle, M., & Davies, P. T. (1999). Depression and heavy alcohol use among adolescents: concurrent and prospective relations. *Development & Psychopathology, 11*(4), 823-44.

Wittchen, H. U. (1996). Critical issues in the evaluation of comorbidity of psychiatric disorders. *British Journal of Psychiatry - Supplement*(30), 9-16.

Wittchen, H. U., Robins, L. N., Cottler, L. B., Sartorius, N., Burke, J. D., & Regier, D. (1991). Cross-cultural feasibility, reliability and sources of variance of the Composite International Diagnostic Interview (CIDI). The Multicentre WHO/ADAMHA Field Trials [published erratum appears in Br J Psychiatry 1992 Jan;160:136]. *British Journal of Psychiatry, 159*, 645-53, 658.

World Health Organisation. (1993). *The ICD-10 Classification of Mental and Behavioural Disorders - Diagnostic Criteria for Research.* Geneva: World Health Organization.

Zablocki, B., Aidala, A., Hansell, S., & White, H. (1991). Marijuana use, introspectiveness, and mental health. *Journal of Health and Social Behavior, 32*(3), 65-79.

Zhang, Z.-F., Morgenstern, H., Spitz, M., Tashkin, D., Yu, G.-P., Marshall, J., Hsu, T., & Schantz, S. (1999). Marijuana use and increased risk of squamous cell carcinoma of the head and neck. *Cancer Epidemiology, Biomarkers and Prevention, 8*, 1071-1078.

Zuardi, A., Shirakawa, I., Finkelfarb, E., & Karniol, I. (1982). Aciton of cannabidiol on the anxiety and other effects produced by delta-9 tetrahydrocannabinol in normal subjects. *Psychopharmacology, 76*, 245-250.

APPENDIX A – RESEARCH ON COMORBIDITY BETWEEN SUBSTANCE USE AND MENTAL HEALTH

ALCOHOL

Alcohol use and other drug use

Clinical research has suggested that persons with substance use disorders are more likely than those with other mental disorders to use tobacco (Hays et al., 1998). Increased rates of tobacco use have been reported by patients reporting greater use of alcohol (Henningfield et al., 1990), among outpatients with more symptoms of problematic use of alcohol (Hays et al., 1998; Henningfield et al., 1990), and among those meeting criteria for alcohol dependence (DiFranza & Guerrera, 1990). US population surveys have found an association between daily cigarette smoking and alcohol use (Henningfield et al., 1990).

The US Epidemiological Catchment Area (ECA) study assessed the prevalence of DSM-III mental disorders in representative samples from 5 sites across the US (Robins & Regier, 1991). The ECA found that those with DSM-III alcohol abuse or dependence were significantly more likely to have used other drugs, and to meet criteria for another drug use disorder (Helzer et al., 1991). Just over one in five persons (22%) who met lifetime criteria for alcohol abuse or dependence also met criteria for another drug use disorder. The majority of such persons met criteria for a cannabis use disorder (Helzer et al., 1991).

Similar results were found in the NCS. Those who met criteria for alcohol abuse or dependence at some time in their lives were more likely to meet criteria for drug abuse or dependence. Drug use disorders were reported in around one third of persons with lifetime alcohol abuse (30% of men, and 33% of women) and among nearly half of persons who met lifetime criteria for alcohol dependence (41% of men and 47% of women) (Kessler et al., 1997).

Alcohol use and depression

The co-occurrence of alcohol use problems and depression – and the reasons for this association - have been the subject of considerable research and debate (Fischer & Goethe, 1998; Grant, Hasin, & Dawson, 1996; Hasin & Glick, 1993; Kendler, Heath, Neale, Kessler, & Eaves, 1993b; Merikangas et al., 1996; Miller, Klamen, Hoffmann, & Flaherty, 1996; Mueller et al., 1994; Schuckit et al., 1997a; Schuckit et al., 1997b; Tomasson & Vaglum, 1998; Windle & Davies, 1999).

Twin research has found that women with alcohol dependence were also highly likely to suffer from depression (Kendler et al., 1993b). The ECA found that persons with DSM-III alcohol abuse or dependence were significantly more likely than those without an alcohol use disorder to meet criteria for an affective disorder such as mania (5.4 times more likely), major depression (1.6 times) or dysthymia (1.7 times) (Helzer et al., 1991).

A study of a nationally representative British cohort found that heavy alcohol use (defined as the number of alcohol units consumed per week) was associated with greater psychological distress (Power, Rodgers, & Hope, 1998). The same study found that those who were abstinent from alcohol also had higher psychological distress compared to light alcohol users, suggesting that there may be a "J-curve" for mental health problems similar to that which has been reported for mortality from cardiovascular disease (Power et al., 1998). This finding has been supported by other reports that light or moderate drinkers tend to report higher levels of psychological well-being, and lower levels of depression (Chick, 1999). This "J curve" has been the subject of much research with regard to moderate alcohol use and *physical* health (Ashley et al., 1997; Chyou et al., 1997; Hanna, Chou, & Grant, 1997; Keil, Chambless, Doring, Filipiak, & Stieber, 1997; Poikolainen & Vartiainen, 1999; Renaud, Gueguen, Schenker, & d'Houtaud, 1998; Rimm, Klatsky, Grobbee, & Stampfer, 1996; Rimm, Williams, Fosher, Criqui, & Stampfer, 1999; Sacco et al., 1999; Thun, Peto, Lopez, & al., 1997; Volk, Cantor, Steinbauer, & Cass, 1997).

The above analyses suggest that problematic alcohol use is associated with higher rate of depression compared to less problematic alcohol use. Furthermore, it appears that *no* alcohol use may also be associated with higher rates of depression than light alcohol use.

Alcohol use and anxiety

A strong relationship between alcohol use disorders and anxiety disorders has also been found in clinical samples. High rates of comorbidity have been found in samples of alcohol-dependent persons, and of persons with anxiety disorders (particularly social phobia) (Himle et al., 1999; Kushner, Sher, & Erickson, 1999; Pozzi, Bacigalupi, & Tempesta, 1997; Schuckit et al., 1997b; Tomasson & Vaglum, 1995; Tomasson & Vaglum, 1998; Tucker & Westermeyer, 1995).

The ECA found that persons with DSM-III alcohol abuse or dependence had significantly higher rates of DSM-III anxiety disorders (panic disorder, obsessive-compulsive disorder, or phobic disorder) (Helzer et al., 1991). These findings were replicated in the NCS (Kessler, 1995; Kessler et al., 1997). A population survey of British adults also found that those with higher levels of anxiety tended to have more problematic alcohol use (Farrell et al., 1998).

Alcohol use and psychosis

Studies of persons suffering from psychotic illnesses such as schizophrenia have consistently found high rates of regular or problematic alcohol use (Brady, Casto, Lydiard, Malcolm, & et al., 1991; Drake, Osher, & Wallach, 1989; Fowler, Carr, Carter, & Lewin, 1998; Lambert, Haasen, Mass, & Krausz, 1997; Modestin, Nussbaumer, Angst, Scheidegger, & Hell, 1997; Mueser et al., 1999; Mueser et al., 2000).

There has been some examination of the association between psychosis and drug use problems in the general population. The ECA estimated that the rate of schizophrenia was 3.4 times higher among those with a DSM-III alcohol use disorder (Helzer et al., 1991). There has also been an analysis using ECA data of the relationship between drug

use and a "self-reported psychotic experience" (Tien & Anthony, 1990). In this paper, a "case" was a person who reported experiencing at least one psychotic symptom (from 12 Diagnostic Interview Schedule (DIS) items) within a follow up year. Persons under 50 years were included, due to low rates of drug use among older persons, and the increased likelihood that older persons would have organic mental disorders. An age-matched sample of cases (n=477) and controls (n=1,818) were compared in a series of logistic regressions that controlled for baseline mental health problems as well as demographic factors; the drug use variables that were significant were retained in the model. Persons who met criteria for a DSM-III alcohol use disorder (RR = 7.9, 95%CI 1.99, 31.41) were still more likely to report at least one psychotic symptom during the follow-up year.

While these findings provided important US population-level information concerning the risks of experiencing at least one psychotic symptom, this association has not been examined in the Australian general population.

CANNABIS

Cannabis use and other drug use

The co-occurrence of cannabis use with other substance use (homotypic comorbidity) has been a consistent finding in the clinical literature. Inpatients with substance use disorders are more likely than those with other mental disorders to use tobacco (Hays et al., 1998). Those using greater amounts of drugs (Henningfield et al., 1990), and outpatients with more symptoms of problematic use of drugs (Hays et al., 1998; Henningfield et al., 1990), are more likely to smoke tobacco.

It is important to obtain representative samples of the general population to ensure that patterns of comorbidity are not affected by selection biases (Berkson, 1946; Galbaud Du Fort et al., 1993). In population studies, an association has also been found between cannabis use and daily cigarette smoking (Henningfield et al., 1990).

From the ECA, it was estimated that around one in 23 persons (4.4%) had met criteria for DSM-III cannabis abuse or dependence in their lifetime, 38% of whom experienced problems in the past year (Anthony & Helzer, 1991). Among cannabis *users*, 36% met lifetime criteria for an alcohol use disorder (Helzer et al., 1991). More detailed information on cannabis use was not specifically reported. Cannabis use disorders were combined with other illicit drugs to define "drug use" disorders (of which cannabis use disorders were the most common). The rate of lifetime alcohol use disorders among persons with *any* drug use disorder was 4.1 times greater than among those without a drug use disorder (Anthony & Helzer, 1991). Similarly, the NCS found that DSM-III-R drug use disorders were likely to co-occur with alcohol use disorders (Kessler et al., 1997).

The Ontario Health Survey, a representative household survey of adults aged 15 to 64 years in Ontario, found that 18% of those who met lifetime criteria for DSM-III-R alcohol abuse or dependence met lifetime criteria for DSM-III-R cannabis abuse or dependence, compared to 1.3% of those who had never met criteria for an alcohol use disorder (Ross, 1995).

Longitudinal research has found that adolescents who use cannabis are more likely to use alcohol, tobacco and other illicit drugs (Fergusson & Horwood, 1997; Fergusson & Horwood, 2000; Kandel, 1984). For example, among adolescents who had used cannabis more than 10 times by age 15-16 years, over half (58%) met criteria for alcohol abuse/dependence by age 16-18 years and two thirds (63%) had used other substances; in comparison, one third (33%) of those who had used cannabis 1-9 times by the age of 15-16 years, and 15% of those who had not used cannabis, met criteria for an alcohol use disorder by age 16-18 years; and 21% and 4%, respectively, had used other drug types (Fergusson & Horwood, 1997).

Cannabis use and depression

There has been recent public concern over putative links between cannabis use and depression, with some claims that cannabis use may cause depression. This may have been of greater concern given the fact that in recent decades, there has been a marked increase in the prevalence of cannabis use among young people in Australia (Australian Institute of Health and Welfare, 1999; Donnelly & Hall, 1994; Makkai & McAllister, 1998), and a dramatic increase in the suicide rate among young Australian males (Cantor, Neulinger, & De Leo, 1999; Lynskey, Degenhardt, & Hall, 2000).

Despite this concern, there has been relatively little research examining the comorbidity between cannabis use and depression. Typically, research in this area has combined substance use disorders. For example, the ECA found that those meeting lifetime criteria for DSM-III drug use disorders had rates of lifetime DSM-III affective disorders that were between 3.5 and 10.7 times higher than those without drug use disorders (Anthony & Helzer, 1991). An analysis of the NCS data found that among those meeting criteria for lifetime major depression, 13% met criteria for lifetime drug dependence and 6.5% for abuse, rates that were 2.0 and 1.8 times higher, respectively, than among those not meeting criteria for lifetime depression (Kessler et al., 1996).

These data are based on *lifetime* comorbidity, which means that a person may have met criteria for the disorders at two very different points in time, rather than within the same year. In the ECA, among those meeting criteria for DSM-III-R major depression in the past year, 7.5% met criteria for drug dependence and 1.1% for drug abuse. These rates were 3.1 and 1.4 times higher, respectively, than among those not meeting criteria for major depression in the past year (Kessler et al., 1996). Again, these figures were not broken down for cannabis abuse and dependence. To date, no analyses have been reported from the ECA on patterns of comorbidity among persons meeting criteria for cannabis abuse and dependence.

In the ECA and NCS persons who were regarded as meeting 12-month criteria for cannabis dependence were those who reported any three symptoms in their lifetime and at least one symptom of dependence in the past year. In contrast, the US National Longitudinal Alcohol Epidemiologic Survey (NLAES), a nationally representative survey of US adults, used criteria that required three dependence criteria to be present within the past year (Grant, 1995). The NLAES showed that those meeting criteria for DSM-IV major depression within the past 12 months had 6.4 times the odds of meeting criteria for DSM-IV cannabis abuse or dependence than those without major depression (6% vs. 1% respectively)(Grant, 1995). Among those meeting criteria for cannabis abuse

and dependence, 14% and 29%, respectively, met criteria for major depression in the past year (Grant & Pickering, 1998).

A study of cannabis use and depressive symptoms in a sample of young adult males found that frequency of cannabis use was not associated with depression (Green & Ritter, 2000). A weak association was observed between early initiation of cannabis use and depression, but it was not significant after controlling for educational attainment, marital status, and other drug use (alcohol and tobacco use) (Green & Ritter, 2000).

A study of Italian male army draftees using cannabis but no other illicit drugs found that problematic cannabis users had a higher rate of DSM-III-R axis I and axis II psychiatric disorders (Troisi, Pasini, Saracco, & Spalletta, 1998). There was also a dose-response relationship between increasing involvement with cannabis use (use, abuse and dependence) and increasing scores on the Beck Depression Inventory (BDI) (Troisi et al., 1998). However, the study did not compare these patterns to the rates among draftees who did not use cannabis, or to those who used cannabis *and* other illicit drugs, who would presumably form a large proportion of cannabis users. Further, the DSM-III-R disorders for which the draftees met criteria were not specified.

Research with a cohort of young adults found that greater involvement with cannabis was associated with a lower degree of life satisfaction, and a higher chance of having consulted a mental health professional or having been hospitalised for a psychiatric disorder (Kandel, 1984). Some research has found that cannabis use may be related to general social functioning (Shedler & Block, 1990). Among a cohort of adolescents followed longitudinally, those who had experimented with cannabis reported better social adjustment than those who had never used cannabis, and those who were heavy users. This U shaped curve was thought to indicate that cannabis use was symptomatic of underlying psychological states, rather than being a cause of them. Problematic cannabis use was hypothesised to be a symptom of emotional distress and maladjustment. Eexperimentation was an indicator of good social adjustment, and never having tried cannabis use was symptomatic of poor social adjustment, anxiety, and emotional constriction (Shedler & Block, 1990). However, these relationships could have been affected by the prevalence of cannabis use in this birth cohort, who went through adolescence when rates of cannabis use were very high in the US (the late 1970s and early 1980s).

More recently, a study examining adolescents classified according to their level of cannabis use (abstainers, experimenters and frequent users) found that both experimenters and frequent users of cannabis had higher levels of depression according to the Brief Symptom Inventory (BSI) (Milich et al., 2000). The researchers defined "heavy" users as those using cannabis at least 40 times *and at least one other illicit drug*, while experimenters had used cannabis less than 10 times and had not used more than one other illicit drug; while abstainers had not used cannabis or any other illicit other drugs. Hence the drug use patterns of these groups differ in more ways than simply their frequency of cannabis use.

Cannabis use and anxiety

There has been some discussion in the research literature over whether cannabis use is related to acute levels of anxiety. Unfortunately, there has been a paucity of research on the relationship, if any, between anxiety *levels*, or anxiety *disorders,* and cannabis use. What follows is a discussion of the limited research available on the subject.

Research involving animals has found that while acute administration of cannabis did not change anxiety-related behaviours compared to controls, chronic cannabis administration significantly reduced anxiety-related behaviours (Sethi et al., 1986). Other research involving animals has suggested that this anxiolytic effect (i.e. anxiety-reducing effect) could be due to one of the major compounds in cannabis, cannabidiol (CBD)(Guimaraes, Chiaretti, Graeff, & Zuardi, 1990). This research found that CBD reduced anxiety behaviours in animals placed in a test situation (Guimaraes et al., 1990), in a similar way to diazepam (a benzodiazepine that has anxiolytic effects) (Guimaraes et al., 1990). Other research has found that another of the major components of cannabis, Δ^9tetrahydrocannabinol (Δ^9THC), may have an anxiogenic effect, i.e. it may *increase* levels of anxiety (Zuardi, Shirakawa, Finkelfarb, & Karniol, 1982). However, cannabidiol was found to reduce this effect. Since administration of the whole cannabis extract was found to *decrease* levels of anxiety (Sethi et al., 1986), it may be that CBD counteracts any anxiogenic effects of THC.

One of the most common adverse reactions to cannabis use, predominantly among naïve users, is an anxiety or panic reaction (Hall et al., 1994; Thomas, 1993; Weil, 1970). This is supported by the findings of research comparing self-reported reactions to previous cannabis use by psychiatric outpatients receiving treatment for DSM-III panic disorder/agoraphobia with panic disorder, depression and control subjects (Szuster, Pontius, & Campos, 1988). Persons with panic disorder reported more feelings of anxiety after cannabis use than depressed persons or controls (Szuster et al., 1988). The authors concluded that although persons with panic disorder might be just as likely to have ever tried cannabis, they were less likely to continue to do so.

While this research has explored acute anxiogenic effects of cannabis use, a separate issue is whether chronic cannabis use is associated with anxiety of a more lasting nature. The study of US adolescents discussed above (Milich et al., 2000) found that frequent cannabis users had higher levels of anxiety according to the BSI than those who did not use cannabis, or who had only experimented with it (Milich et al., 2000). It must be remembered that "heavy" users were using at least one other illicit drug type, while "experimenters" had not used more than one other drug type, and "abstainers" had used no other drug types.

Research involving self-reported experiences of chronic cannabis use among adults has provided mixed results, which appear to depend according to the group sampled. One study of 50 long term cannabis users - who had used cannabis on at least 5,000 separate occasions - found that at least half of users reported cannabis occasionally or frequently relieved unpleasant mood states such as anxiety or depression, while the remainder felt it was unrelated to such feelings (Gruber, Pope, & Oliva, 1997). Conversely, one third of the same users reported that cannabis occasionally led to feelings of anxiety, with 10% reporting the same for feelings of depression (Gruber et al., 1997). Given that these persons had used cannabis on so many occasions, it is perhaps unsurprising that few reported unpleasant symptoms associated with their cannabis use.

In the study of male army draftees discussed above, scores on the Spielberger State Anxiety Index (STAI-Y1) were higher among those more heavily involved with cannabis use (dependent or abuse) (Troisi et al., 1998). Cannabis involvement was *not* associated with scores on Spielberger's Trait Anxiety Index (STAI-Y-2) (Troisi et al., 1998).

A sample of 460 members of a commune who had used cannabis were interviewed in a study of the cannabis use and psychological distress (Zablocki, Aidala, Hansell, & White, 1991). Overall, neither the amount or the recency of cannabis use were associated with increased psychological distress as measured by the Symptom Checklist-90's Global Severity Index, the depression index, or the anxiety index (Zablocki et al., 1991). However, in individuals characterised as "highly introspective" - on a scale that included such items as "How much do you think about yourself?" and "How much do you try to figure yourself out?" - recent cannabis use was associated with higher levels of anxiety and psychological distress (Zablocki et al., 1991).

Finally, in the ECA, rates of lifetime DSM-III anxiety disorders were between 1.9 and 3.3 times more common among those meeting lifetime criteria for DSM-III drug abuse or dependence compared to among those without such a disorder (Anthony & Helzer, 1991).

Cannabis use and psychosis

The association between schizophrenia and cannabis use – and the possible reasons for this association - have both been the subject of considerable attention in the literature (Hall, 1998). Clinical samples of persons with schizophrenia have typically revealed high rates of cannabis *use* (Barbee, Clark, Crapanzo, Heintz, & Kehoe, 1989; Cohen & Klein, 1970; Wheatley, 1998). A survey of schizophrenic outpatients in an Australian regional service found that 17% had used cannabis in the past 6 months, with 4% meeting DSM-III-R criteria for cannabis abuse and a further 9% for dependence (Fowler et al., 1998). In a survey of persons with psychotic illnesses in contact with health services in three Australian cities (Melbourne, Perth and Canberra), 25% of persons met lifetime criteria for a cannabis *use disorder* (Jablensky et al., 2000). This is consistent with US and UK research finding high rates of cannabis use disorders among clinical samples of persons with psychotic illnesses (Dixon, Haas, Weiden, Sweeney, & Frances, 1991; Drake & Wallach, 1989; Mueser et al., 2000).

There is less evidence on the association between psychosis and cannabis use in general population samples. The ECA found that schizophrenia was 5.9 times more common among persons meeting lifetime criteria for DSM-III drug abuse or dependence (Anthony & Helzer, 1991). In the analysis of ECA data by Tien and Anthony discussed above (1990), daily cannabis use (RR = 2.0, 95%CI 1.25, 3.12) remained a significant predictor of reporting at least one psychotic symptom during the follow-up year (Tien & Anthony, 1990).

Tobacco use and other drug use

In clinical settings, tobacco use is very common among persons with other substance use problems (Hays et al., 1998). It is more common among patients using greater amounts of alcohol and other drugs (Henningfield et al., 1990), and among those with 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). A US study also found that nicotine dependence strongly predicted dependence upon alcohol, cannabis and other drugs in a community sample of young adults in the US (Breslau, Kilbey, & Andreski, 1991).

Tobacco use and depression

The link between tobacco use and depression has also received a great amount of attention in the research literature (Breslau, 1995; Breslau et al., 1993; Covey, 1999; Glass, 1990; Glassman, 1993; Glassman, 1998; Glassman, Helzer, & Covey, 1990; Pomerleau, 1997). High rates of smoking have been found among those in contact with treatment services for depression (Glass, 1990; Glassman, 1993; Glassman, 1998; Hughes, Hatsukami, Mitchell, & Dahlgren, 1986).

Epidemiological research conducted in the US on the prevalence of smoking among adults in the community has found that tobacco smokers had higher rates of depression (Anda et al., 1990; Breslau et al., 1991; Kandel, Davies, Karus, & Yamaguchi, 1986). Longitudinal studies have revealed an association between tobacco use, depression and anxiety among adolescents and young adults in both US (Breslau et al., 1991; Breslau, Kilbey, & Andreski, 1994) and Australian (Patton et al., 1998) samples. Research involving twins has suggested that nicotine dependence and major depression may have common genetic causes (Kendler et al., 1993a).

Tobacco use and anxiety

Epidemiological research has been conducted in the US on smoking among adults in the community (Anda et al., 1990; Breslau et al., 1991; Kandel et al., 1986), and longitudinal studies have examined tobacco use, depression and anxiety among young adults in the US (Breslau et al., 1991; Breslau et al., 1994) and Australia (Patton et al., 1998). These studies have found that depression and anxiety are more common among US adult smokers, and that young adult smokers are more likely to have symptoms of anxiety and depression.

Tobacco use and psychosis

There has been a 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; Fowler et al., 1998; Glass, 1990; Glassman, 1993; Glassman, 1998; Goff,

Henderson, & Amico, 1992; Hughes et al., 1986; Masterson & O'Shea, 1984; O'Farrell, Connors, & Upper, 1983). Recent research also suggested that persons with psychotic illnesses in the UK general population have an extremely high prevalence of tobacco use (Farrell et al., 1998). Some clinical research has suggested that persons with schizophrenia smoke greater amounts of tobacco and use higher tar cigarettes (Masterson & O'Shea, 1984), a factor that may serve to increase the physical health risks of their tobacco use.

APPENDIX B – TABLES

Table 6: Weighted prevalence and univariate odds ratios (OR) and 95% confidence intervals (95%CI) for other drug use according to alcohol, cannabis and tobacco use

	% (SE)	OR	95%CI
Sedative, stimulant or opiate use			
No alcohol use	2.8 (0.4)	1.00	--
Alcohol use	3.0 (0.4)	1.23	0.94, 1.60
Alcohol abuse	10.9 (2.8)	4.13	2.41, 7.10
Alcohol dependence	15.3 (3.2)	7.26	5.15, 10.26
Sedative, stimulant or opiate use			
No cannabis use	2.6 (0.2)	1.00	--
Cannabis use	14.4 (2.2)	5.81	4.37, 7.69
Cannabis abuse	12.4 (4.1)	5.35	2.72, 10.49
Cannabis dependence	26.8 (9.0)	11.32	7.61, 16.79
Sedative, stimulant or opiate use			
No tobacco use	2.8 (0.2)	1.00	--
Tobacco use	6.1 (0.5)	2.27	1.84, 2.78
Sedative, stimulant, opiate use disorder			
No alcohol use	0.7 (0.3)	1.00	--
Alcohol use	0.6 (0.1)	0.74	0.44, 1.24
Alcohol abuse	2.2 (1.3)	2.90	1.00, 8.50
Alcohol dependence	7.3 (2.3)	9.96	5.70, 17.37
Sedative, stimulant, opiate use disorder			
No cannabis use	0.5 (0.1)	1.00	--
Cannabis use	3.1 (1.1)	5.58	3.14, 9.98
Cannabis abuse	4.1 (3.2)	7.27	2.22, 23.76
Cannabis dependence	17.6 (6.7)	34.52	20.49, 56.83
Sedative, stimulant, opiate use disorder			
No tobacco use	0.4 (0.1)	1.00	--
Tobacco use	2.4 (0.4)	4.69	3.10, 7.09

Table 7: Weighted prevalence and univariate odds ratios (OR) and 95% confidence intervals (95%CI) of DSM-IV affective and anxiety disorders according to alcohol, tobacco and cannabis use

	% (SE)	OR	95%CI
DSM-IV affective disorder			
No alcohol use	7.3 (0.4)	1.00	--
Alcohol use	5.5 (0.3)	0.82	0.70, 0.97
Alcohol abuse	6.1 (2.0)	0.90	0.50, 1.60
Alcohol dependence	24.0 (4.0)	4.47	3.48, 5.74
DSM-IV affective disorder			
No cannabis use	6.2 (0.3)	1.00	--
Cannabis use	12.1 (2.7)	2.24	1.73, 2.91
Cannabis abuse	18.6 (5.3)	2.88	1.61, 5.17
Cannabis dependence	13.6 (2.6)	2.85	1.86, 4.35
DSM-IV affective disorder			
No tobacco use	5.4 (0.4)	1.00	--
Tobacco use	10.9 (0.8)	2.20	1.90, 2,54
DSM-IV anxiety disorder			
No alcohol use	6.5 (0.5)	1.00	--
Alcohol use	4.5 (0.4)	0.78	0.65, 0.93
Alcohol abuse	4.9 (1.9)	0.73	0.37, 1.44
Alcohol dependence	19.5 (2.7)	4.42	3.39, 5.75
DSM-IV anxiety disorder			
No cannabis use	5.4 (0.3)	1.00	--
Cannabis use	8.0 (1.2)	1.78	1.31, 2.41
Cannabis abuse	6.4 (2.8)	1.10	0.44, 2.73
Cannabis dependence	16.5 (2.6)	4.30	2.88, 6.40
DSM-IV anxiety disorder			
No tobacco use	4.5 (0.3)	1.00	--
Tobacco use	9.3 (0.8)	2.42	2.07, 2.83

Table 8: Weighted prevalence and univariate odds ratios (OR) and confidence intervals (95%CI) of screening positively for psychosis according to alcohol, tobacco and cannabis use

	% (SE)	OR	95%CI
No alcohol use	0.7 (0.2)	1.00	--
Alcohol use	0.8 (0.1)	1.06	0.67, 1.68
Alcohol abuse	1.8 (1.3)	2.55	0.88, 7.39
Alcohol dependence	4.3 (1.3)	6.37	3.59, 11.34
No cannabis use	0.7 (0.1)	1.00	--
Cannabis use	2.4 (0.7)	3.56	2.05, 6.23
Cannabis abuse	3.9 (2.8)	4.64	1.43, 14.98
Cannabis dependence	6.8 (3.2)	10.80	5.91, 19.89
No tobacco use	0.5 (0.1)	1.00	--
Tobacco use	2.3 (0.4)	4.65	3.19, 6.75