

Characteristics of DSM-IV and ICD-10 cannabis dependence among Australian adults: results from the National Survey of Mental Health and Wellbeing

Wendy Swift *, Wayne Hall, Maree Teesson

National Drug and Alcohol Research Centre, University of New South Wales, Sydney, NSW 2052, Australia

Received 25 April 2000; accepted 18 August 2000

Abstract

A representative sample ($n = 10\,641$) of Australian adults completed a structured diagnostic interview assessing the prevalence of mental and substance use disorders in the last year. The prevalence of DSM-IV (1.5%) and ICD-10 (1.7%) cannabis dependence was similar. DSM-IV and ICD-10 dependence criteria comprised unidimensional syndromes. The most common symptoms among dependent and non-dependent users were difficulties with controlling use and withdrawal, although there were marked differences in symptom prevalence. Dependent users reported a median of four symptoms. There was good to excellent diagnostic concordance ($kappas = 0.7–0.9$) between systems for dependence but not for abuse/harmful use ($Y = 0.4$). These findings provide some support for the validity of cannabis dependence. © 2001 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: DSM-IV; ICD-10; Cannabis dependence; Australian adults

1. Introduction

General population surveys indicate adults frequently meet criteria for cannabis dependence when assessed using standardised dependence instruments (Anthony and Helzer, 1991; Anthony et al., 1994; Kandel et al., 1997). For example, among the 1394 Epidemiologic Catchment Area Study respondents who had used cannabis daily for at least 2 weeks, 17.2% felt dependent, compared to 1.3% of those who never used at this level. Their most common symptoms were: requiring larger amounts, or having psychological problems attributed to cannabis (both 20.6%), social problems attributed to cannabis (17%) and inability to reduce use (8.4%). Few reported health problems (4.6%) or withdrawal sickness (2.9%) (Anthony and Trinkoff, 1989).

Observational studies of non-clinical samples of long-term and regular users also report symptoms such as withdrawal, tolerance, compulsive use, impaired ability to control use and continued use despite problems

(Swift et al., 1998, 2000). In clinical samples some cannabis users experience great difficulty moderating their use, and seek professional assistance to cut down or stop. Many report core symptoms of the syndrome such as salience of cannabis use and narrowing of repertoire, and experience cannabis-related problems in multiple life domains (Stephens et al., 1993, 2000; Budney et al., 1998, 1999; Copeland et al., 2000).

The nature of cannabis dependence has not been well delineated. For example, there is little research on whether the symptoms of cannabis dependence (Edwards et al., 1981) are substantially intercorrelated in a manner indicating a single underlying factor (Nunnally, 1967), which would increase the validity of the drug dependence syndrome.

A second issue that has rarely been examined concerns the comparability of different ways of operationalising and measuring cannabis dependence. Psychometric theory dictates that if the DSM and ICD have a common conceptual underpinning, and if the underlying concept of dependence is valid, then different instruments designed to operationalise dependence should agree on case identification.

* Corresponding author. Tel.: +61-2-9398-9333; fax: +61-2-9399-7143.

E-mail address: w.swift@unsw.edu.au (W. Swift).

The National Survey of Mental Health and Wellbeing (NSMHWB) is the first epidemiological study of the prevalence of mental and substance use disorders in the Australian adult population (Australian Bureau of Statistics, 1998). It used a reliable and valid diagnostic interview to produce diagnostic and symptom level information for the DSM-IV and ICD-10 systems, permitting comparisons to be made between the two.

This paper presents national general population data on symptoms of cannabis dependence, and examines unidimensionality and diagnostic concordance for both classification systems. Previous research has rarely examined these issues among cannabis users in large, representative samples. More general data on the survey findings, including the prevalence and correlates of DSM-IV cannabis use disorders, are reported elsewhere (Andrews et al., 1999; Hall et al., 1999; Swift et al., 1999).

1.1. Aims

Specifically, the analyses address the following questions:

1. What, and how many, DSM-IV and ICD-10 cannabis dependence symptoms were reported by dependent and non-dependent cannabis users in the last year?
2. Did the DSM-IV and ICD-10 cannabis dependence symptoms comprise unidimensional syndromes?
3. What was the extent of agreement between the DSM-IV and ICD-10 diagnoses of cannabis use disorders, in terms of (i) whether or not a cannabis user met a diagnosis, and (ii) severity of dependence among dependent users?

2. Methods

A more detailed discussion of the NSMHWB sampling design and its implementation has been reported elsewhere (Australian Bureau of Statistics, 1998; Hall et al., 1999).

2.1. Sampling

These data were collected from a stratified, multi-stage probability sample of the Australian population aged 18 years and older, living in private dwellings. Initial contact was by mail, notifying the household of the impending interview. For each selected household the person (aged 18 or more) with the next birthday was chosen. The age and gender characteristics of the sample were weighted to match the age and gender distributions in the national census. The overall response rate was 78%, representing 10 641 participants.

2.2. The interview

Mental disorders were assessed by a modified version of the Composite International Diagnostic Interview (CIDI) (World Health Organization, 1997), which was adapted for the NSMHWB to yield information on: substance use disorders (abuse/harmful use and dependence), affective disorders, and anxiety disorders. It is the most widely used interview in large epidemiological studies, and its assessments for substance use disorders have been shown to have adequate test-retest and inter-rater reliability (Hall et al., 1999). All CIDI modules produce ICD-10 and DSM-IV diagnoses, and can be administered by trained lay interviewers. Assessment was restricted to symptoms in the last 12 months to maximise accurate symptom recall.

Cannabis use disorders were assessed whenever a respondent reported using cannabis more than five times in the last 12 months.

2.3. Procedure

Fieldwork was conducted by the Australian Bureau of Statistics (ABS) in 1997. Trained survey interviewers met with each designated respondent to administer the interview. All interviewer procedures were predetermined and all inputs and scoring outputs were standardised. Responses were recorded directly onto laptop computer by the interviewer.

2.4. Analyses and estimation procedures

2.4.1. Prevalence estimates

This paper presents weighted population estimates of the 12-month prevalence of DSM-IV and ICD-10 cannabis dependence and abuse/harmful use symptoms. Prevalence estimates were derived using a complex estimation procedure, which ensured that they conformed to independent population estimates by state, part of state, age and sex. The standard errors of prevalence estimates were calculated using the equivalent of the Jackknife method of replication (obtained from purpose written syntax from SUDAAN's manufacturer, Research Triangle Institute). All prevalence estimates and standard errors were calculated in SUDAAN, Release 7.5 (Shah et al., 1997).

2.4.2. Factor structure of dependence symptoms

Principal components analysis (PCA) was conducted on the unweighted data to investigate whether DSM-IV and ICD-10 dependence symptoms comprised unidimensional scales. Principal components were retained on the basis of an examination of the scree plot, and if they had an eigenvalue of 1 or more (Hair et al., 1995). In addition, Cronbach's alpha (Cronbach, 1951), an indicator of internal consistency reliability, was calcu-

lated for each measure of cannabis dependence. If these are unidimensional scales the value of alpha should be 0.70 or greater (Streiner and Norman, 1995). The analyses were conducted on tetrachoric correlation matrices (as each criterion was present or absent), entered into the Factor module of SYSTAT Version 6 (SYSTAT, 1994a,b).

2.4.3. Concordance between DSM-IV and ICD-10 diagnoses

Cohen's kappa (Cohen, 1960) assessed the extent to which the two systems agreed on whether a cannabis user received cannabis dependence and cannabis use disorder diagnoses. Agreement between DSM-IV abuse and ICD-10 harmful use diagnoses, which had a low prevalence, was assessed using Yule's *Y* statistic (Yule, 1912), which is robust against low/high base rates (Spitznagel and Helzer, 1985). Pearson product moment correlations assessed agreement on dependence severity (i.e. the number of dependence criteria met) among dependent cannabis users. Analyses were computed using unweighted estimates in SPSS for Windows (6.1.4) (SPSS, 1993).

3. Results

3.1. Prevalence of DSM-IV and ICD-10 cannabis use disorders

Approximately one in 12 Australians (7.1%) had consumed cannabis more than five times in the preceding 12 months ('cannabis users'). In this time, 2.2% of adults were diagnosed with a DSM-IV cannabis use disorder (dependence: 1.5%; abuse: 0.7%), and 1.7% with an ICD-10 cannabis use disorder, predominantly dependence (1.6%). Among cannabis users, almost one third (31.7%) had a DSM-IV cannabis use disorder (dependence: 21%; abuse: 10.7%) and one quarter (23.6%) had an equivalent ICD-10 diagnosis (dependence: 22%; harmful use: 1.5%).

While the residual diagnoses of abuse (DSM-IV) or harmful use (ICD-10) were uncommon, this was particularly marked for the ICD-10 criteria. This largely explains the discrepancy in the prevalence of cannabis use disorders between the two diagnostic systems.

3.2. Factor structure of cannabis dependence

There was good evidence that the DSM-IV and ICD-10 criteria, measured by the CIDI-Auto, represented unidimensional cannabis dependence syndromes in this population-based sample. For each system, all criteria had substantial, significant positive loadings on the first principal component (DSM-IV: ≥ 0.76 ; ICD-10: ≥ 0.79), which accounted for at least two-thirds of

the total variance (DSM-IV: 65.7%; ICD-10: 71%). The value of Cronbach's alpha for each scale (DSM-IV: 0.75; ICD-10: 0.77) was indicative of good internal consistency and unidimensionality.

3.3. Symptoms of cannabis dependence

3.3.1. DSM-IV

Withdrawal symptoms and a persistent desire or attempts to control use were the most commonly reported DSM-IV dependence symptoms; withdrawal was most highly ranked among dependent users, with a secondary ranking among non-dependent users (Table 1). The least common symptom among both groups was neglecting other activities. There was a major discrepancy between groups in the prevalence of most symptoms; this was most marked for criteria 5 and 7 (time spent using cannabis and continued use despite problems), and least marked for criterion 4 (persistent desire to control use). The rank ordering of symptoms between groups was quite similar.

3.3.2. ICD-10

The ICD-10 symptom data were similar, with dependent and non-dependent users ranking difficulties controlling use, followed by withdrawal, as the most common symptoms (Table 2). There was no difference in the rank ordering of symptoms between groups, with the exception of the least frequently reported criteria: criterion 6 (continued use despite problems) among dependent users and criterion 5 (neglect of alternative interests) among non-dependent users. The prevalence of the ICD-10 criterion 5 was much higher among dependent users than its DSM-IV equivalent (criterion 6) (43.9 vs. 9.9%). Again, there was typically a large discrepancy between the groups in symptom prevalence, although this was less marked for the most commonly reported criteria (1 and 2).

For both DSM-IV and ICD-10 dependence, few symptoms were typically experienced (dependent users: median = 4; non-dependent users: median = 0). One quarter (DSM-IV: 27.1%; ICD-10: 27.4%) of dependent users experienced five or more symptoms.

3.4. Agreement between DSM-IV and ICD-10 classifications of cannabis use disorders

There was excellent concordance between DSM-IV and ICD-10 cannabis dependence diagnoses, expressed as the proportion of cannabis users who qualified for each diagnosis (kappa = 0.9). This was reflected in their substantial agreement on the severity of cannabis dependence, or number of symptoms reported ($r = 0.8$) by dependent users. In contrast, there was only modest agreement between DSM-IV abuse and ICD-10 harmful use diagnoses (Yule's *Y* = 0.4), which is consistent

with their differing diagnostic criteria (Tables 1 and 2). While there was substantial cross-system agreement regarding the proportion of users diagnosed with a cannabis use disorder (either dependence or abuse/harmful use) ($\kappa = 0.7$), this value is probably constrained by the lack of concordance between the categories of abuse (DSM-IV) and harmful use (ICD-10).

4. Discussion

The DSM-IV and ICD-10 dependence criteria appeared to represent coherent syndromes in this general population sample, providing some support for the validity of a cannabis dependence syndrome. This strengthens the international literature reporting reasonable coherence for cannabis dependence symptoms among clinical and community samples (Hasin et al., 1988; Rounsaville et al., 1993; Morgenstern et al., 1994; Feingold and Rounsaville, 1995), although other Australian research on long-term cannabis users has identified multiple dimensions (Swift et al., 1998).

In general, the evidence for the unidimensionality of dependence for most drug classes is impressive (Kosten et al., 1987; Hasin et al., 1988; Rounsaville et al., 1993; Morgenstern et al., 1994; Feingold and Rounsaville, 1995), although not universal (Phillips et al., 1987; Muthén et al., 1993a,b; Johnson et al., 1996). Discrepant findings may be partly due to nosological, sampling and analytic differences between studies. However, factor models may differ according to subgroups (Muthén et al., 1993a), which may have clinical

implications for aetiology, treatment response and prognosis (Johnson et al., 1996). For example, unidimensionality may imply that treatment components can be transported among drug classes because there is a universal core domain called 'dependence' (Chick, 1980).

Dependent users typically reported only four dependence symptoms, and only one quarter experienced more than four of the seven DSM-IV, and six ICD-10, dependence criteria. The most common DSM-IV and ICD-10 symptoms reported by dependent and non-dependent users were difficulties controlling use and withdrawal. These and the abuse/harmful use data indicate that, while even dependent users in this national sample frequently experienced such symptoms, they less commonly reported major cannabis-related consequences in their daily activities (e.g. impaired role functioning) or social, psychological or legal problems. Further analyses will examine the extent and nature of cannabis-related disability in this group.

Although symptom prevalence differed between groups, their rank ordering was quite similar. An examination of whether these unidimensional scales are severity scales, and whether certain symptoms can differentiate dependence severity, is also forthcoming. Symptom patterns may also vary across different user populations. A clearer understanding of such variations may provide insight into their aetiological and clinical implications (Nelson et al., 1999). While these data had a 12-month focus, a longer term examination of symptom progression may present a clearer picture over the life course.

Table 1
Weighted prevalence (%) ($\pm$ S.E.) of (i) DSM-IV abuse symptoms, and (ii) DSM-IV dependence symptoms (by dependence diagnosis) among cannabis users

	Total, <i>n</i> = 722	Non-dependent, <i>n</i> = 572	Dependent, <i>n</i> = 150
<i>Abuse^a</i>			
1. Recurrent cannabis use resulting in a failure to fulfill major role obligations at work, school, or home	3.5 (0.9) ^b	0.9 (0.5) ^b	13.4 (3.2)
2. Recurrent cannabis use in situations in which it is physically hazardous	18.0 (1.6)	10.5 (2.0)	46.2 (7.2)
3. Recurrent cannabis-related legal problems	2.7 (1.3) ^b	1.4 (0.6) ^b	7.5 (5.6) ^b
4. Continued use despite persistent or recurrent social or interpersonal problems caused or exacerbated by cannabis	2.2 (1.1) ^b	0.8 (0.5) ^b	7.5 (5.6) ^b
<i>Dependence</i>			
1. Tolerance	22.1 (2.7)	8.6 (1.5)	72.6 (4.8)
2. Withdrawal/withdrawal relief	29.7 (2.5)	14.0 (2.3)	88.8 (3.2)
3. Cannabis used in larger amounts or for longer than intended	19.0 (2.1)	7.3 (1.6)	62.8 (4.5)
4. Persistent desire or unsuccessful efforts to control use	36.6 (2.3)	23.2 (2.2)	86.9 (3.0)
5. Great deal of time spent in obtaining, using and recovering	9.2 (1.4)	0.4 (0.8) ^b	42.5 (6.3)
6. Important activities given up or reduced	2.2 (1.2) ^b	2.1 (1.0) ^b	9.9 (6.1) ^b
7. Continued use despite knowledge of physical or psychological problem	8.8 (1.5)	1.3 (0.6) ^b	37.0 (7.1) ^b

^a An abuse diagnosis was made only if the person did not meet criteria for cannabis dependence.

^b These estimates may be unreliable because of small sample sizes, and should be used with caution.

Table 2
Weighted prevalence (%) ($\pm$ S.E.) of (i) ICD-10 harmful use symptoms, and (ii) ICD-10 dependence symptoms (by dependence diagnosis) among cannabis users.

	Total, <i>n</i> = 722	Non-dependent, <i>n</i> = 565	Dependent, <i>n</i> = 157
<i>Harmful use</i> ^a			
Cannabis use was responsible for or substantially contributed to physical or psychological harm, including impaired judgment or dysfunctional behavior	10.7 (1.6)	1.9 (0.6)	41.4 (4.3)
<i>Dependence</i>			
1. A strong desire or sense of compulsion to take cannabis	13.6 (2.4)	2.3 (0.6) ^b	53.0 (7.1)
2. Impaired capacity to control cannabis use, in terms of onset, termination or levels of use	43.2 (3.1)	28.6 (3.0)	94.7 (1.5)
3. Withdrawal/withdrawal relief	29.7 (2.5)	12.4 (2.1)	90.5 (2.8)
4. Tolerance	22.1 (2.7)	8.4 (1.4)	70.1 (6.1)
5. Preoccupation with cannabis use, manifested by neglect of alternative pleasures, or by a great deal of time spent in activities necessary to obtain, take or recover from its effects	10.1 (1.3)	0.5 (0.8) ^b	43.9 (5.2)
6. Persisting cannabis use despite clear evidence of harmful consequences	8.8 (1.5)	1.2 (0.6) ^b	35.4 (6.5)

^a A harmful use diagnosis was made only if the person did not meet criteria for cannabis dependence.

^b These estimates may be unreliable because of small sample sizes, and should be used with caution.

Despite the omission of cannabis withdrawal from the DSM-IV, it has been commonly reported among non-clinical (Anthony and Trinkoff, 1989; Wiesbeck et al., 1996; Swift et al., 1998, 2000) and clinical (Stephens et al., 1993; Budney et al., 1999; Copeland et al., 2000) samples of cannabis users. It has also been observed in human experimental studies (Georgotas and Zeidenberg, 1979; Jones et al., 1981; Haney et al., 1999) and precipitated in animals using a cannabinoid antagonist (Aceto et al., 1995; Rubino et al., 1998). The precipitated syndrome is more definitive than that which occurs under naturalistic conditions, which may also be less pronounced than alcohol and opiate withdrawal (Haney et al., 1999). This literature suggests that the relationship between withdrawal, relapse and the maintenance of heavy use (Haney et al., 1999) is worth exploring, as is the development of cannabis withdrawal management strategies.

Further support for a cannabis dependence syndrome was provided by the impressive concordance between NSMHWB DSM-IV and ICD-10 cannabis dependence diagnoses and dependence severity among dependent users. These imply that both systems were measuring the same construct. While a small literature suggests that there is generally good concordance between these systems for dependence diagnoses for many drug classes, the evidence is more equivocal on cannabis dependence. Some studies have reported good to excellent agreement, using different instruments in diverse samples (Rapaport et al., 1993; Rounsaville et al., 1993; Hasin et al., 1997), while others have reported more discordant findings (Cottler et al., 1991; Compton et al., 1996a,b). Even in the studies in which good agreement was exhibited, it was typically lower for cannabis than other drug classes.

The NSMHWB revealed poor agreement among the abuse and harmful use categories, consistent with the literature cited above. In all these studies, for all drug classes, there was poor agreement between DSM abuse and ICD-10 harmful use, primarily reflecting conceptual differences in the two diagnostic categories. It is also possible that the very low prevalence of abuse/harmful use and the attendant large standard errors may have constrained the assessment of validity, although Yule's statistic is more robust in these circumstances.

In summary, this study has provided some support for the validity of a cannabis dependence syndrome in a general population sample, using both major diagnostic systems. Some have argued that cannabis dependence has few clinical implications. Among general population samples, in which most users report few symptoms, the majority may not experience significant disability or require or seek professional intervention (Anthony and Helzer, 1991). Nevertheless, some users find it extremely difficult to control their use and seek such help (Stephens et al., 1993; Budney et al., 1998; Copeland et al., 1999). A key challenge is to identify when, and with whom, to provide what sort of intervention.

Acknowledgements

The NSMHWB was designed, developed and conducted with funding from the Mental Health Branch of the Commonwealth Department of Health and Family Services. Development and testing of the computerised survey instrument was undertaken by Gavin Andrews, Lorna Peters, and other staff at the Clinical Research

Unit for Anxiety Disorders, and the WHO Collaborating Centre in Mental Health at St Vincent's Hospital. The design of the survey was overseen and approved by the Technical Advisory Group comprising: Professors A. Scott Henderson (Chair); Gavin Andrews; Wayne Hall; Helen Herman; Assen Jablensky and Bob Kosky. Survey fieldwork and implementation, and the enumeration, compilation and initial analyses of the data were undertaken by the Australian Bureau of Statistics.

References

- Aceto, M.D., Scates, S.M., Lowe, J.A., Martin, B.R., 1995. Cannabinoid precipitated withdrawal by the selective cannabinoid receptor antagonist, SR 141716A. *Eur. J. Pharmacol.* 282, R1–R2.
- Andrews, G., Hall, W., Teesson, M., Henderson, S., 1999. The Mental Health of Australians. Mental Health Branch, Commonwealth Department of Health and Family Services, Canberra National Survey of Mental Health and Wellbeing Report 2.
- Anthony, J.C., Helzer, J.E., 1991. Syndromes of drug abuse and dependence. In: Robins, L.N., Regier, D.A. (Eds.), *Psychiatric Disorders in America: The Epidemiologic Catchment Area Study*. Free Press, Macmillan, New York, pp. 116–154.
- Anthony, J.C., Trinkoff, A.M., 1989. United States epidemiological data on drug use and abuse: how are they relevant to testing abuse reliability on drugs? In: Fischman, M.W., Mello, N.K. (Eds.), *Testing for Abuse Liability of Drugs in Humans*. National Institute on Drug Abuse, Rockville, MD, pp. 241–266 Research Monograph No. 92.
- Anthony, J.C., Warner, L.A., Kessler, R.C., 1994. Comparative epidemiology of dependence on tobacco, alcohol, controlled substances, and inhalants: basic findings from the National Comorbidity Survey. *Exp. Clin. Psychopharmacol.* 2, 244–268.
- Australian Bureau of Statistics, 1998. National Survey of Mental Health and Wellbeing of Adults: Users' Guide. Australian Bureau of Statistics, Canberra.
- Budney, A.J., Radonovich, K.J., Higgins, S.T., Wong, C., 1998. Adults seeking treatment for marijuana dependence: a comparison to cocaine-dependent treatment-seekers. *Exp. Clin. Psychopharmacol.* 6, 419–426.
- Budney, A.J., Novy, P.L., Hughes, J.R., 1999. Marijuana withdrawal among adults seeking treatment for marijuana dependence. *Addiction* 94, 1311–1321.
- Chick, J., 1980. Is there a unidimensional alcohol dependence syndrome? *Br. J. Addict.* 75, 265–280.
- Cohen, J., 1960. A coefficient of agreement for nominal scales. *Educ. Psychol. Meas.* 20, 37–46.
- Compton, W.M., Cottler, L.B., Dorsey, K.B., Spitznagel, E.L., Mager, D.E., 1996a. Comparing assessments of DSM-IV substance dependence disorders using CIDI-SAM and SCAN. *Drug Alcohol Depend.* 41, 179–187.
- Compton, W.M., Cottler, L.B., Dorsey, K.B., Spitznagel, E.L., Mager, D.E., 1996b. Structured and semi-structured assessment of ICD-10 substance dependence disorders: CIDI-SAM vs. SCAN. *Int. J. Methods Psychiatr. Res.* 6, 285–293.
- Copeland, J., Rees, V., Swift, W., 1999. Help seeking among a sample entering treatment for cannabis dependence. *Aust. Fam. Physician* 28, 540–541 Letter to the Editor.
- Copeland, J., Swift, W., Rees, V., 2000. Clinical profile of participants in a brief intervention program for cannabis use disorder *Journal of Substance Abuse Treatment* (in press).
- Cottler, L.B., Helzer, J.E., Mager, D., Spitznagel, E.L., Compton, W.M., 1991. Agreement between DSM-III and III-R substance use disorders. *Drug Alcohol Depend.* 29, 17–25.
- Cronbach, L.J., 1951. Coefficient alpha and the internal structure of tests. *Psychometrika* 16, 297–334.
- Edwards, G., Arif, A., Hodgson, R., 1981. Nomenclature and classification of drug- and alcohol-related problems: a WHO memorandum. *Bull. Who* 59, 225–242.
- Feingold, A., Rounsaville, B., 1995. Construct validity of the dependence syndrome as measured by DSM-IV for different psychoactive substances. *Addiction* 90, 1661–1669.
- Georgotas, A., Zeidenberg, P., 1979. Observations on the effects of 4 weeks of heavy marijuana smoking on group interaction and individual behavior. *Compr. Psychiatry* 20, 427–432.
- Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1995. *Multivariate Data Analysis with Readings*, fourth ed. Prentice-Hall, Englewood Cliffs, NJ.
- Hall, W., Teesson, M., Lynskey, M., Degenhardt, L., 1999. The 12-month prevalence of substance use and ICD-10 substance use disorders in Australian adults: findings from the National Survey of Mental Health and Wellbeing. *Addiction* 94, 1541–1550.
- Haney, M., Ward, A.S., Comer, S.D., Foltin, R.W., Fischman, M.W., 1999. Abstinence symptoms following oral THC administration to humans. *Psychopharmacology* 141, 385–394.
- Hasin, D.S., Grant, B.F., Harford, T.C., Endicott, J., 1988. The drug dependence syndrome and related disabilities. *Br. J. Addict.* 83, 45–55.
- Hasin, D., Grant, B.F., Cottler, L., Blaine, J., Towle, L., Üstün, B., Sartorius, N., 1997. Nosological comparisons of alcohol and drug diagnoses: a multisite, multi-instrument international study. *Drug Alcohol Depend.* 47, 217–226.
- Johnson, E.O., Breslau, N., Anthony, J.C., 1996. The latent dimensionality of DIS/DSM-III-R nicotine dependence. *Addiction* 91, 583–588.
- Jones, R.T., Benowitz, N., Herning, R.I., 1981. The clinical relevance of cannabis tolerance and dependence. *J. Clin. Pharmacol.* 21, 143S–152S.
- 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 US population. *Drug Alcohol Depend.* 44, 11–29.
- Kosten, T.R., Rounsaville, B.J., Babor, T.F., Spitzer, R.L., Williams, J.B.W., 1987. Substance-use disorders in DSM-III-R. *Br. J. Psychiatry* 151, 834–843.
- Morgenstern, J., Langenbucher, J., Labouvie, E.W., 1994. The generalizability of the dependence syndrome across substances: an examination of some properties of the proposed DSM-IV dependence criteria. *Addiction* 89, 1105–1113.
- Muthén, B.O., Grant, B., Hasin, D., 1993a. The dimensionality of alcohol abuse and dependence: factor analysis of DSM-III-R and proposed DSM-IV criteria in the 1988 National Health Interview Survey. *Addiction* 88, 1079–1090.
- Muthén, B.O., Hasin, D., Wisnicki, K.S., 1993b. Factor analysis of ICD-10 symptom items in the 1988 National Health Interview Survey on Alcohol Dependence. *Addiction* 88, 1071–1077.
- Nelson, C.B., Rehm, J., Üstün, B., Grant, B., Chatterji, S., 1999. Factor structure for DSM-IV substance disorder criteria endorsed by alcohol, cannabis, cocaine and opiate users: results from the WHO reliability and validity study. *Addiction* 94, 843–856.
- Nunnally, J.C., 1967. *Psychometric Theory*. McGraw-Hill, New York.
- Phillips, G.T., Gossop, M., Edwards, G., Sutherland, G., Taylor, C., Strang, J., 1987. The application of the SODQ to the measurement of the severity of opiate dependence in a British sample. *Br. J. Addict.* 82, 691–699.
- Rapaport, M.H., Tipp, J.E., Schuckit, M.A., 1993. A comparison of ICD-10 and DSM-III-R criteria for substance abuse and dependence. *Am. J. Drug Alcohol Abuse* 19, 143–151.

- Rounsaville, B.J., Bryant, K., Babor, T., Kranzler, H., Kadden, R., 1993. Cross-system agreement for substance use disorders. *Addiction* 88, 337–348.
- Rubino, T., Patrini, G., Massi, P., Fuzio, D., Viganò, D., Giagnoni, G., Parolaro, D., 1998. Cannabinoid-precipitated withdrawal: a time-course study of the behavioral aspect and its correlation with cannabinoid receptors and G protein expression. *J. Pharmacol. Exp. Ther.* 285, 813–819.
- Shah, B.V., Barnwell, B.G., Bieler, G.S., 1997. SUDAAN User's Manual, Release 7.5. Research Triangle Institute, Research Triangle Park, NC.
- Spitznagel, E.L., Helzer, J.E., 1985. A proposed solution to the base rate problem in the kappa statistic. *Arch. Gen. Psychiatry* 42, 725–728.
- SPSS, 1993. SPSS for Windows, Base System User's Guide, Release 6.1.4. SPSS, Chicago.
- Stephens, R.S., Roffman, R.A., Simpson, E.E., 1993. Adult marijuana users seeking treatment. *J. Consult. Clin. Psychol.* 61, 1100–1104.
- Stephens, R.S., Roffman, R.A., Curtin, L., 2000. Comparison of extended versus brief treatment for marijuana use. *J. Consult. Clin. Psychol.* (in press).
- Streiner, D.L., Norman, G.R. (Eds.), 1995. *Health Measurement Scales: A Practical Guide to Their Development and Use*, second ed. Oxford University Press, Oxford.
- Swift, W., Hall, W., Didcott, P., Reilly, D., 1998. Patterns and correlates of cannabis dependence among long-term users in an Australian rural area. *Addiction* 93, 1149–1160.
- Swift, W., Hall, W., Teesson, M., 1999. Cannabis Use Disorders among Australian Adults: Findings from the National Survey of Mental Health and Wellbeing. National Drug and Alcohol Research Centre, Sydney Technical Report No. 78.
- Swift, W., Hall, W., Copeland, J., 2000. One year follow-up of cannabis dependence among long-term cannabis users in Sydney, Australia. *Drug Alcohol Depend.* 59, 309–318.
- SYSTAT, 1994a. SYSTAT for DOS: Advanced Applications, Version 6 edition. SYSTAT, Evanston, IL.
- SYSTAT, 1994b. SYSTAT for DOS: Using SYSTAT, Version 6 edition. SYSTAT, Evanston, IL.
- Wiesbeck, G.A., Schuckit, M.A., Kalmijn, J.A., Tipp, J.E., Bucholz, K.K., Smith, T.L., 1996. An evaluation of the history of a marijuana withdrawal syndrome in a large population. *Addiction* 91, 1469–1478.
- World Health Organization, 1997. Composite International Diagnostic Interview (CIDI) Core Version 2.1, 12-Month Version. World Health Organization, Geneva.
- Yule, G.U., 1912. On the methods of measuring association between two attributes. *J. R. Stat. Soc.* 75, 581–642.