Addiction

RESEARCH REPORT

doi:10.1111/j.1360-0443.2008.02221.x

Cannabis use and later life outcomes

David M. Fergusson & Joseph M. Boden

University of Otago, Christchurch School of Medicine and Health Sciences, New Zealand

ABSTRACT

Aim To examine the associations between the extent of cannabis use during adolescence and young adulthood and later education, economic, employment, relationship satisfaction and life satisfaction outcomes. **Design** A longitudinal study of a New Zealand birth cohort studied to age 25 years. **Measurements** Measures of: cannabis use at ages 14–25; university degree attainment to age 25; income at age 25; welfare dependence during the period 21–25 years; unemployment 21–25 years; relationship quality; life satisfaction. Also, measures of childhood socio-economic disadvantage, family adversity, childhood and early adolescent behavioural adjustment and cognitive ability and adolescent and young adult mental health and substance use. **Findings** There were statistically significant bivariate associations between increasing levels of cannabis use at ages 14–21 and: lower levels of degree attainment by age 25 ($P < 0.0001$); lower income at age 25 ($P < 0.01$); higher levels of welfare dependence ($P < 0.0001$); higher unemployment ($P < 0.0001$); lower levels of relationship satisfaction ($P < 0.001$); and lower levels of life satisfaction ($P < 0.0001$). These associations were adjusted for a range of potentially confounding factors including: family socio-economic background; family functioning; exposure to child abuse; childhood and adolescent adjustment; early adolescent academic achievement; and comorbid mental disorders and substance use. After adjustment, the associations between increasing cannabis use and all outcome measures remained statistically significant ($P < 0.05$). **Conclusions** The results of the present study suggest that increasing cannabis use in late adolescence and early adulthood is associated with a range of adverse outcomes in later life. High levels of cannabis use are related to poorer educational outcomes, lower income, greater welfare dependence and unemployment and lower relationship and life satisfaction. The findings add to a growing body of knowledge regarding the adverse consequences of heavy cannabis use.

Keywords Cannabis use, education, life satisfaction, longitudinal study, mental health, unemployment, welfare.

Correspondence to: David M. Fergusson, Christchurch Health and Development Study, Christchurch School of Medicine and Health Sciences, PO Box 4345, Christchurch, New Zealand. E-mail: dm.fergusson@otago.ac.nz

Submitted 2 November 2007; initial review completed 4 February 2008; final version accepted 27 February 2008

INTRODUCTION

In recent years, there have been growing concerns and debates about the effects of cannabis use on the health and wellbeing of young people. These concerns have been motivated by evidence of growing cannabis use in young people [1,2], changes in the nature and strength of cannabis [3,4] and by growing evidence linking cannabis to mental health and other problems [1,5–9]. While the role of cannabis in encouraging psychosocial problems in young people remains controversial, there is growing evidence from both epidemiology and neuroscience that cannabis may be more harmful than believed previously [10,11].

An aspect of these concerns that requires further attention is the extent to which the use, and in particular heavy use, of cannabis may have adverse consequences for a number of important life-course outcomes, including educational achievement, income, welfare dependence, unemployment, relationship satisfaction and life satisfaction. Specifically, there have been frequent references in the literature on cannabis to suggest that cannabis use may reduce educational achievement [12–14], increase welfare dependence [15], reduce income [16] and lead to impaired interpersonal relationships [17]. While there is some evidence of statistical linkage with these outcomes, it may be suggested that the apparent associations between cannabis use and these life-course outcomes may reflect the presence of uncontrolled sources of confounding [18].

In this study, we use data gathered over the course of a 25-year longitudinal study to examine the linkages

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

between cannabis use prior to the age of 21 and subsequent life-course outcomes including: educational achievement, income, welfare dependence, unemployment, relationship satisfaction and life satisfaction. The aims of the analysis are to document the associations between cannabis use by 21 and subsequent life history, and to examine the extent to which these associations may be explained by confounding factors that were associated with patterns of cannabis use in adolescence and young adulthood.

METHODS

The data were gathered during the course of the Christchurch Health and Development Study (CHDS). In this study a birth cohort of 1265 children (635 males, 630 females) born in the Christchurch (New Zealand) urban region in mid-1977 has been studied at birth, 4 months, 1 year and annually to age 16 years, and again at ages 18, 21 and 25 years [19,20]. The analyses were based on the 1003 study participants for whom information was available for outcomes at ages 21–25 years (79% of the original sample). All study information was collected on the basis of signed and informed consent from study participants.

Estimated amount of cannabis use, ages 14–21

At the age 15-, 16-, 18- and 21-year assessments, participants were questioned as to the number of occasions on which they had used cannabis during each year since the previous assessment. For the purposes of the present study, these estimates were summed for the period 14–21 years to arrive at an estimate of the total number of times participants had used cannabis during this period [mean = 74.98, standard deviation (SD) = 134.80]. The estimate of the total number of times participants had used cannabis during the period 15–21 years was then used to classify participants using a categorical measure of total cannabis use, ranging from 1 (never used cannabis) to 6 (used cannabis 400+ times). The mean number of occasions for the group using cannabis 400+ times was 491.6 (SD = 56.4). The rates of cannabis use observed in the present study were consistent with those observed in other New Zealand birth cohorts [21,22], and were similar to those observed in Australian samples [1].

In addition, two further measures of frequency of cannabis use were created. First, the annual data on the amount of cannabis use were classified into a series of class intervals as follows: did not use cannabis during the year; used less than monthly on average (one to 11 times); used at least monthly on average (12–50 times); and used at least weekly on average (more than 50 times). These were then averaged over the period 14–21 years to arrive at an estimate of the average frequency of cannabis use during the period 14–21 years. Secondly, an estimate of the number of occasions on which participants had used cannabis during the period 14–18 years was calculated by summing the annual estimates of cannabis use for this period.

Outcome measures

Education/income

At ages 21 and 25, cohort members were questioned concerning their history of enrolment in tertiary education and training and any educational/vocational qualifications obtained. This information was used to classify participants on a dichotomous measure of degree (Bachelor's level or above) attainment prior to age 25 years. Also at age 25, participants were asked to estimate their personal gross income from all sources over the previous 12 months. This estimate served as the measure of personal income (in New Zealand dollars) at age 25 (mean = NZ$28 539; SD = NZ$18 688).

Welfare dependence/unemployment

Participants were questioned at age 25 about their receipt of social welfare benefits during the period 21–25 years. The percentage of cohort members who reported receiving an unemployment benefit, domestic purposes benefit (available to single parents with dependent children) or a sickness or invalids' benefit at any point in the period 21–25 years served as the outcome measure. In addition, participants were also questioned as to their patterns of employment and unemployment for each year during the period 21–25 years. Participants who reported being unemployed and looking for work at any time during the period 21–25 years were classified as having been unemployed at some point by age 25.

Relationship and life satisfaction

Relationship satisfaction was assessed using the 25-item Intimate Relations Scale [23]. Participants were asked to respond to the measure with reference to their most recent intimate romantic relationship of 1 month or longer duration at age 25. This measure was scaled so that higher scores on the measure reflected greater levels of relationship satisfaction ($\alpha = 0.86$). Life satisfaction at age 25 was assessed on the basis of 12 custom-written items assessing satisfaction with a range of life domains, including work, family, friends, leisure pursuits and life in general. Participants responded to the items on a four-point scale, ranging from very happy to very unhappy. For the purposes of the present analysis, scale scores were created by summing the responses to the 12 items to create a general life satisfaction measure for each age.

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

This measure was scaled so that lower scores on the measure reflected greater levels of life satisfaction ($\alpha = 0.88$).

Covariate factors

A range of covariate factors were chosen for the analyses, based on: (i) their correlation with cannabis use at ages 14–21; and (ii) previous research on the present cohort suggesting that the factors were related to both cannabis use and later life outcomes. The following covariate factors were chosen for inclusion in the analyses:

Socio-economic status of family of origin

- *Family socio-economic status at birth.* Assessed at birth using the scale developed for New Zealand by Elley & Irving [24].
- *Maternal age.* Recorded at birth.
- *Maternal education.* Mother's highest educational attainment, recorded at birth.
- *Average family living standards (ages 0–10).* Assessed via a global assessment of material living standards made by an interviewer during each year, and averaged across this period.

Family functioning

- *Changes of parents (age 15).* A measure reflecting the total number of parental changes occurring up to age 15 as a result of separation/divorce, reconciliation, fostering, remarriage or death [25].
- *Parental history of offending, alcohol problems and illicit drug use.* Parental illicit drug use was assessed at age 11 (24.9% of the sample were thus classified), and at age 15 offending (12.4% of the sample) and alcohol problems (11.9% of the sample) were assessed.
- *Family adversity measure.* A measure of family problems was calculated using a count measure of 38 different measures of family disadvantage during the period 0–15 years, including measures of disadvantaged parental background, poor prenatal health practices and perinatal outcomes and disadvantageous child-rearing practices [26].

Exposure to child abuse

- *Childhood sexual abuse.* Assessed at ages 18 and 21 for the period prior to age 16 years, spanning an array of abusive experiences, resulting in a four-level classification of severity [27].
- *Parental use of physical punishment.* Assessed at ages 18 and 21 for the period during childhood, resulting in a four-level classification of the extent to which physical punishment was used [28].

Childhood and adolescent adjustment

- *Conduct and attention problems (ages 7–13).* Assessed via parent and teacher reports of child behaviour from ages 7–13 [29] and averaged over that period, using scales based on items from Rutter *et al.*'s [30] and Conners' [31,32] behaviour rating scales.
- *Parental attachment (age 14).* Assessed at age 14 using the quality of parental attachment scale by Armsden & Greenberg [33].
- *Deviant peer affiliations (ages 15–21).* Assessed at ages 16, 18 and 21, on the extent to which their friends used tobacco, alcohol or illicit drugs, had problems associated with substance use or engaged in criminal behaviour or had problems with the law, and averaged over the period.

Adolescent academic achievement

- *Grade average (ages 11–13).* Assessed via teacher reports of achievement in reading, written expression, spelling and mathematics and averaged over these domains and age intervals.
- *Cognitive ability (age 13).* Assessed via the Test of Scholastic Abilities (TOSCA: [34]), which tests the extent to which the child exhibits the skills and competencies necessary for academic work in high school.

Comorbid mental health disorders and substance use

- *Major depression (ages 15–21).* At age 16, items from the Diagnostic Interview Schedule for Children (DISC, [35]) were used to assess DSM-III-R [36] symptom criteria for major depression. At ages 18 and 21 this was assessed using the Composite International Diagnostic Interview (CIDI, [37]) items and DSM-IV [38] diagnostic criteria.
- *Alcohol consumption, cigarette smoking and other illicit drug use (ages 15–21).* At ages 16, 18 and 21, cohort members were questioned about their use of alcohol, tobacco and a range of illicit drugs other than cannabis since the previous assessment. As with the assessment of cannabis use, each assessment included questions about other substance use for each year of the assessment period.

Statistical analyses

The associations between cannabis use during the period 14–21 years and outcomes from ages 21–25 were tested for linear trend using the Mantel–Haenszel χ^2 test of linear trend for percentage outcomes, and by one-way analysis of variance for means. In order to adjust the associations for potentially confounding factors, logistic

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

regression (for dichotomous outcomes) and multiple regression (for continuous outcomes) models were fitted to the data, using forward and backward methods of covariate inclusion in order to arrive at stable models. In all models the extent of cannabis use was assumed to be related linearly to the outcome. From the parameters of the fitted models, estimates of the adjusted associations between cannabis use and the outcome measures were computed. For dichotomous outcomes, these estimates were based on the adjusted odds ratios between cannabis use and later outcomes. For continuous outcomes, adjusted means were computed using standard least squares methods. The adjusted means correspond to the hypothetical mean scores that would have been observed if all the participants had mean scores for all covariates, and varied only on cannabis use.

In addition, in order to examine the robustness of the analyses to alternative forms of classification of cannabis use, the above analyses were repeated using an alternative method of classifying cannabis consumption during the period 14–21 years. In these analyses, cannabis consumption was represented by a measure of frequency with which participants used cannabis during each year during the period 14–21 years, averaged over those years.

Also, to examine the extent to which early (prior to age 18) cannabis consumption was associated with later adverse outcomes, the analyses above were repeated using a measure of total cannabis consumption during the period 14–18 years.

RESULTS

Associations between cannabis use by age 21 and life outcomes at age 25

Table 1 shows the cohort classified into six groups based on the estimated amount of cannabis used by age 21. These groups range from non-users to those who had used cannabis on more than 400 occasions prior to age 21. For each group, the Table reports on measures of a series of outcome variables, including: university degree attainment by age 25; income at age 25; welfare dependence during the period 21–25 years; unemployment during the period 21–25 years; relationship satisfaction at age 25; and overall life satisfaction at age 25. In all cases, results were tested for linear trend (see Methods). The Table shows that the increasing use of cannabis prior to the age of 21 was associated with declining levels of degree attainment ($P < 0.0001$), declining income ($P < 0.01$), increasing welfare dependence ($P < 0.0001$), increasing unemployment ($P < 0.0001$), declining relationship satisfaction ($P < 0.001$) and declining life satisfaction ($P < 0.0001$).

Table 1 Associations between level of cannabis use, ages 14–21, and life outcomes ages 21–25.

	Number of occasions using cannabis ages 14–21						
Outcome	*Never (n = 319)*	*1–99 (n = 450)*	*100–199 (n = 74)*	*200–299 (n = 62)*	*300–399 (n = 44)*	*400+ (n = 54)*	*P**
Education/income							
% Gained university degree by age 25	35.9	27.1	18.3	10.5	9.1	1.9	<0.0001
Mean (SD) personal income. age 25 (in NZ$000)	31.7 (20.6)	34.0 (21.3)	27.1 (15.2)	27.6 (20.2)	27.5 (17.0)	26.1 (16.9)	<0.01
Welfare/unemployment							
% Welfare dependent, ages 21–25	25.0	31.7	40.9	52.6	54.6	57.7	<0.0001
% Unemployed, ages 21–25	21.3	23.2	25.4	42.1	40.9	51.9	<0.0001
Relationships/life satisfaction							
Mean (SD) relationship quality score, age 25	27.0 (7.4)	24.9 (8.5)	23.5 (8.8)	23.6 (8.3)	23.3 (8.1)	23.3 (8.8)	<0.001
Mean (SD) life satisfaction score, age 25†	19.9 (4.7)	20.4 (4.5)	22.8 (4.4)	20.9 (4.5)	22.6 (4.6)	22.0 (5.2)	<0.0001

*Mantel–Haenszel χ^2 test of linear trend for percentages: one-way analysis of variance for means. †Higher scores indicate lower levels of life satisfaction. SD: standard deviation.

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

Table 2 Odds ratios (OR) and adjusted mean scores for the associations between level of cannabis use, ages 14–21, and life outcomes ages 21–25, after adjustment for confounding factors and comorbid mental health disorders and substance use.*

	Number of occasions using cannabis ages 14–21						
Outcome	*Never*	*1–99*	*100–199*	*200–299*	*300–399*	*400+*	*P*†
Education/income							
% Gained university degree by age 25							
OR	1	0.75	0.57	0.43	0.32	0.24	<0.01
(95% CI)	–	(0.62–0.92)	(0.38–0.85)	(0.23–0.78)	(0.14–0.72)	(0.09–0.66)	
Adjusted mean personal income, age 25							
(in NZ$000)	33.2	31.6	30.0	28.5	26.9	25.3	<0.01
(95% CI)	(31.4–34.9)	(30.4–32.8)	(28.6–31.5)	(26.2–30.7)	(23.7–30.1)	(21.2–29.4)	
Welfare/unemployment							
% Welfare dependent, ages 21–25							
OR	1	1.37	1.89	2.60	3.57	4.90	<0.0001
(95% CI)	–	(1.23–1.54)	(1.51–2.37)	(1.85–3.65)	(2.27–5.61)	(2.79–8.63)	
% Unemployed, ages 21–25							
OR	1	1.27	1.61	2.04	2.59	3.28	<0.01
(95% CI)	–	(1.06–1.51)	(1.13–2.29)	(1.20–3.47)	(1.28–5.24)	(1.36–7.94)	
Relationships/life satisfaction							
Adjusted mean relationship quality, age 25	25.9	25.4	24.9	24.4	23.9	23.5	<0.05
(95% CI)	(25.1–26.7)	(24.8–26.0)	(24.2–25.6)	(23.4–25.5)	(22.5–25.4)	(21.6–25.4)	
Adjusted mean life satisfaction score, age 25‡	20.2	20.6	20.9	21.3	21.7	22.0	<0.01
(95% CI)	(19.8–20.6)	(20.3–20.9)	(20.6–21.3)	(20.8–21.8)	(21.0–22.3)	(21.1–22.9)	

*Factors included: maternal age; maternal education; family socio-economic status at birth; average family standard of living (ages 0–10); exposure to childhood sexual and physical abuse; parental changes by age 15; family adversity; parental illicit drug use; parental criminality; parental alcoholism; parental attachment (age 14); conduct problems (ages 7–13); attention problems (ages 7–9); association with deviant peers (ages 15–21); cognitive ability score (age 13); grade point average (ages 11–13); other illicit drug use (ages 15–21); frequency of alcohol use (ages 15–21); frequency of cigarette smoking (ages 15–21); psychotic symptoms (ages 15–21); major depression (ages 15–21). †Multiple logistic regression for dichotomous outcomes, multiple linear regression for continuous outcomes. ‡Higher scores indicate lower levels of life satisfaction. CI: confidence interval; OR: odds ratio.

Associations between cannabis use by age 21 and life outcomes at age 25, adjusted for confounding factors and comorbid mental health disorders and substance use

One explanation for the pattern of associations shown in Table 1 is that these reflect the presence of selection and confounding processes relating to both cannabis use and life-course choices and decisions. To address issues of confounding, the results were adjusted for a large number of covariate factors by fitting logistic regression and multiple regression models to the data, including covariate factors. These covariates included measures of the socio-economic background of the family of origin, measures of family functioning and exposure to adversity, exposure to child sexual and physical abuse, measures of childhood and adolescent adjustment, measures of academic achievement in early adolescence and measures of comorbid mental health disorders and substance use.

Table 2 shows the associations between cannabis use by the age of 21 and outcomes during the period 21–25 years, adjusted for the covariate factors and comorbid mental health disorders and substance use. For dichotomous outcomes, estimates of the odds ratio and 95% confidence intervals are presented, whereas for continuous outcomes adjusted mean scores and 95% confidence intervals are presented. This Table shows that, even following extensive adjustment for prospectively assessed covariate factors, there were still significant trends for increasing cannabis use to be associated with lower levels of degree attainment ($P < 0.01$), lower income ($P < 0.01$), higher levels of welfare dependence ($P < 0.0001$), higher levels of unemployment ($P < 0.01$), lower levels of relationship satisfaction ($P < 0.05$) and lower overall life satisfaction ($P < 0.01$).

Supplementary analyses

In order to examine the robustness of the above findings to alternative classifications of cannabis consumption, the analyses above were repeated using a categorical measure reflecting the relative frequency of consumption

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

during each year, averaged over the period 14–21 years (see Methods). These analyses revealed the following pattern of results:

1 Increasing frequency of cannabis use during the period 14–21 years was associated significantly with the following outcome measures by age 25: lower levels of degree attainment ($P < 0.0001$); lower income ($P < 0.01$); higher welfare dependence ($P < 0.0001$); higher unemployment ($P < 0.0001$); lower levels of relationship satisfaction ($P < 0.001$); and lower levels of overall life satisfaction ($P < 0.0001$).
2 After adjustment for confounding factors, frequency of cannabis use during the period 14–21 years remained associated significantly with: lower levels of degree attainment ($P < 0.01$); lower income ($P < 0.05$); higher welfare dependence ($P < 0.0001$); higher unemployment ($P < 0.05$); and lower levels of relationship satisfaction ($P < 0.05$) and overall life satisfaction ($P < 0.0001$).

The results of this analysis suggest that the findings of a persistent association between cannabis use and later adverse outcomes were robust to alternative methods of classifying cannabis use.

In addition, in order to examine the extent to which early (prior to age 18) cannabis use was associated with later adverse outcomes, the analyses reported above were repeated using a measure of the amount of cannabis used during the period 14–18 years, in place of the measure of cannabis use during the period 14–21 years (see Methods). In general, the results of the analyses were congruent with those using the age 14–21 measure of cannabis use. These analyses revealed the following pattern of results.

1 Increasing frequency of cannabis use during the period 14–18 years was associated significantly with the following outcome measures by age 25: lower levels of degree attainment ($P < 0.0001$); lower income ($P < 0.05$); higher welfare dependence ($P < 0.0001$); higher unemployment ($P < 0.0001$); lower levels of relationship satisfaction ($P < 0.001$); and lower levels of overall life satisfaction ($P < 0.0001$).
2 After adjustment for confounding factors, frequency of cannabis use during the period 14–18 years remained associated significantly with: lower levels of degree attainment ($P < 0.05$); lower income ($P < 0.05$); higher welfare dependence ($P < 0.001$); higher unemployment ($P < 0.05$); and lower levels of relationship satisfaction ($P < 0.05$) and overall life satisfaction ($P < 0.01$).

DISCUSSION

This research has used data gathered over the course of a 25-year longitudinal study to examine the relationship between the use of cannabis up to the age of 21 and subsequent life outcomes including: educational achievement, income, welfare dependence, partnership relationships and life satisfaction. This analysis showed that, even following extensive control for factors present prior to and during adolescence, increasing cannabis use was associated with: declining educational achievement; reduced income at 25; increased welfare dependence; reduced relationship satisfaction; and reduced life satisfaction. These results were found to be robust to alternative methods of classifying cannabis use prior to age 21. Similar, but slightly less marked results were observed for cannabis use by the age of 18. In all cases, there was a marked dose–response relationship between cannabis consumption and less positive outcomes by age 25.

These results are consistent with at least three explanations of the association between cannabis use and life outcomes. First, these associations may be explained by residual confounding. Although we were able to control a wide range of confounding factors, including both factors antecedent to cannabis use and comorbid substance use and mental health disorders, the possibility remains that the observed associations may be explained by non-observed sources of confounding [18]. Secondly, the results may reflect the consequences of cannabis use for neuropsychological functioning. This conjecture is supported by a growing body of evidence that suggests that the use of cannabis may lead to both acute and long-term changes in the structure and function of the brain [39–40]. Thirdly, the origins of these associations may be social rather than biological. In particular, cannabis use is more frequent in social contexts which may encourage what have been described by Kandel and colleagues as 'anticonventional' attitudes [41]. Given this, it may be suggested that the apparent linkages between cannabis use and life-course outcomes are, in fact, symptomatic of the greater participation of cannabis users in social contexts that discourage educational achievement and material success. While the present study was unable to clarify which (if any) of these explanations is correct, future research should endeavour to untangle the biological and social factors that may link cannabis use to later life outcomes.

The findings of the present study are consistent with a growing body of evidence that has raised concerns about the extent to which cannabis use may have adverse psychosocial consequences that span: increased risks of psychotic illness [6]; increased risks of depression and other mental illness [1,7]; and increased risks of other illicit substance use [9]. These recent findings have raised a strong challenge to the view that cannabis is a relatively harmless drug, and suggest that the heavy use of cannabis may have multiple adverse consequences. While there have been suggestions that these associations can be

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

explained by residual confounding [18], it is notable that despite extensive efforts at statistical control in a growing number of studies, this has not been shown to be the case. On the other hand, it should also be noted that a large number of individuals in the present cohort who used cannabis experienced very few adverse consequences, and that outcomes for those using cannabis sparingly (fewer than 100 times) did not differ markedly from those who did not use cannabis at all. The results of the present study suggest that the risk of adverse outcomes increases progressively with increasing levels of cannabis use.

These findings are, of course, subject to a number of limitations. First, they report on the experiences of a particular group of individuals born at a specific time and reared in a specific social context. Secondly, the results are based on self-report data, and thence will be subject to errors of reporting and reminiscence. Thirdly, as noted above, the results may be subject to residual confounding. Fourthly, it is also possible that the present study has underestimated the extent of cannabis use, particularly for those using cannabis most frequently, which suggests that the estimates presented here may be somewhat conservative in nature. None the less, within these limitations the results of the present study suggest that the increasing use of cannabis in adolescence may result in longer-term educational, economic and personal disadvantage in young adulthood.

Acknowledgements

This research was funded by grants from the Health Research Council of New Zealand, the National Child Health Research Foundation, the Canterbury Medical Research Foundation and the New Zealand Lottery Grants Board.

References

1. Rey J. M., Sawyer M., Raphael B., Patton G. C., Lynskey M. Mental health of teenagers who use cannabis. *Br J Psychiatry* 2002; **180**: 216–21.
2. von Sydow K., Lieb R., Pfister H., Hoefler M., Sonntag H., Wittchen H. U. The natural course of cannabis use, abuse and dependence over four years: a longitudinal community study of adolescents and young adults. *Drug Alcohol Depend* 2001; **64**: 347–61.
3. Licata M., Verri P., Beduschi G. Delta9 THC content in illicit cannabis products over the period 1997–2004 (first four months). *Ann Ist Super Sanita* 2005; **41**: 483–5.
4. ElSohly M. A., Ross S. A., Mehmedic Z., Arafat R., Yi B., Banahan B. F. 3rd. Potency trends of delta9-THC and other cannabinoids in confiscated marijuana from 1980–1997. *J Forensic Sci* 2000; **45**: 24–30.
5. Fergusson D. M., Horwood L. J., Swain-Campbell N. R. Cannabis use and psychosocial adjustment in adolescence and young adulthood. *Addiction* 2002; **97**: 1123–35.
6. Fergusson D. M., Poulton R., Smith P. F., Boden J. M. Cannabis and psychosis: a summary and synthesis of the evidence. *BMJ* 2006; **332**: 172–6.
7. Hayatbakhsh M. R., Najman J. M., Jamrozik K., Mamun A. A., Alati R., Bor W. Cannabis and anxiety and depression in young adults: a large prospective study. *J Am Acad Child Adolesc Psychiatry* 2007; **46**: 408–17.
8. Looby A., Earleywine M. Negative consequences associated with dependence in daily cannabis users. *Subst Abuse Treat Prev Policy* 2007; **2**: 3.
9. Fergusson D. M., Boden J. M., Horwood L. J. Cannabis use and other illicit drug use: testing the cannabis gateway hypothesis. *Addiction* 2006; **101**: 556–69.
10. Hall W., Pacula R. L. *Cannabis Use and Dependence: Public Health and Public Policy*. Melbourne: Cambridge University Press; 2003.
11. Hall W. D. Cannabis use and the mental health of young people. *Aust NZ J Psychiatry* 2006; **40**: 105–13.
12. Fergusson D. M., Horwood L. J., Beautrais A. L. Cannabis and educational achievement. *Addiction* 2003; **98**: 1681–92.
13. Fergusson D. M., Horwood L. J., Lynskey M. T., Madden P. A. F. Early reactions to cannabis predict later dependence. *Arch Gen Psychiatry* 2003; **60**: 1033–9.
14. Patton G. C., Coffey C., Lynskey M. T., Reid S., Hemphill S., Carlin J. B. *et al*. Trajectories of adolescent alcohol and cannabis use into young adulthood. *Addiction* 2007; **102**: 607–15.
15. Schmidt L., Weisner C., Wiley J. Substance abuse and the course of welfare dependency. *Am J Public Health* 1998; **88**: 1616–22.
16. Degenhardt L., Chiu W. T., Sampson N., Kessler R. C., Anthony J. C. Epidemiological patterns of extra-medical drug use in the United States: evidence from the National Comorbidity Survey Replication, 2001–2003. *Drug Alcohol Depend* 2007; **90**: 210–23.
17. Newcomb M. D., Bentler P. M. Impact of adolescent drug use and social support on problems of young adults: a longitudinal study. *J Abnorm Psychol* 1988; **97**: 64–75.
18. Macleod J., Oakes R., Copello A., Crome I., Egger M., Hickman M. *et al*. Psychological and social sequelae of cannabis and other illicit drug use by young people: a systematic review of longitudinal, general population studies. *Lancet* 2004; **363**: 1579–88.
19. Fergusson D. M., Horwood L. J. The Christchurch Health and Development Study: review of findings on child and adolescent mental health. *Aust NZ J Psychiatry* 2001; **35**: 287–96.
20. Fergusson D. M., Horwood L. J., Shannon F. T., Lawton J. M. The Christchurch Child Development Study: a review of epidemiological findings. *Paediatr Perinat Epidemiol* 1989; **3**: 278–301.
21. Poulton R., Moffitt T. E., Harrington H., Milne B. J., Caspi A. Persistence and perceived consequences of cannabis use and dependence among young adults: implications for policy. *NZ Med J* 2001; **114**: 544–7.
22. Poulton R. G., Brooke M., Moffitt T. E., Stanton W. R., Silva P. A. Prevalence and correlates of cannabis use and dependence in young New Zealanders. *NZ Med J* 1997; **110**: 68–70.
23. Braiker H., Kelley H. Conflict in the development of close relationships. In: Burgess R., Huston T., editors. *Social Exchange and Developing Relationships*. New York: Academic Press; 1979, p. 127–54.

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction

24. Elley W. B., Irving J. C. Revised socio-economic index for New Zealand. *NZ J Educ Stud* 1976; **11**: 25–36.
25. Fergusson D. M., Horwood L. J., Lynskey M. T. Family change, parental discord and early offending. *J Child Psychol Psychiatry* 1992; **33**: 1059–75.
26. Fergusson D. M., Horwood L. J., Lynskey M. T. The childhoods of multiple problem adolescents: a 15-year longitudinal study. *J Child Psychol Psychiatry* 1994; **35**: 1123–40.
27. Fergusson D. M., Horwood L. J., Lynskey M. T. Childhood sexual abuse, adolescent sexual behaviors and sexual revictimization. *Child Abuse Negl* 1997; **21**: 789–803.
28. Fergusson D. M., Lynskey M. T. Physical punishment/maltreatment during childhood and adjustment in young adulthood. *Child Abuse Negl* 1997; **21**: 617–30.
29. Fergusson D. M., Horwood L. J., Lloyd M. Confirmatory factor models of attention deficit and conduct disorder. *J Child Psychol Psychiatry* 1991; **32**: 257–74.
30. Rutter M., Tizard J., Whitmore K., Education, Health and Behaviour. London: Longmans; 1970.
31. Conners C. K. A teacher rating scale for use in drug studies with children. *Am J Psychiatry* 1969; **126**: 884–8.
32. Conners C. K. Symptom patterns in hyperkinetic, neurotic and normal children. *Child Dev* 1970; **41**: 667–82.
33. Armsden G. C., Greenberg M. T. The inventory of parent and peer attachment: individual differences and their relationship to psychological well-being in adolescence. *J Youth Adolesc* 1987; **16**: 427–54.
34. Reid N. A., Jackson P. F., Gilmore A., Croft C. *Test of Scholastic Abilities*. Wellington: New Zealand Council for Educational Research; 1981.
35. Costello A., Edelbrock C., Kalas R., Kessler M., Klaric S. A. *Diagnostic Interview Schedule for Children (DISC)*. Bethesda, MD: National Institute of Mental Health; 1982.
36. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 3rd edition, revised. Washington, DC: American Psychiatric Association; 1987.
37. World Health Organization. *Composite International Diagnostic Interview (CIDI)*. Geneva: World Health Organization; 1993.
38. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. Washington, DC: American Psychiatric Association; 1994.
39. Matochik J. A., Eldreth D. A., Cadet J. L., Bolla K. I. Altered brain tissue composition in heavy marijuana users. *Drug Alcohol Depend* 2005; **77**: 23–30.
40. Eldreth D. A., Matochik J. A., Cadet J. L., Bolla K. I. Abnormal brain activity in prefrontal brain regions in abstinent marijuana users. *Neuroimage* 2004; **23**: 914–20.
41. Kandel D. B., Davies M., Karis D., Yamaguchi K. The consequences in young adulthood of adolescent drug involvement: an overview. *Arch Gen Psychiatry* 1986; **43**: 746–54.

© 2008 The Authors. Journal compilation © 2008 Society for the Study of Addiction