Adolescent precursors of cannabis dependence: findings from the Victorian Adolescent Health Cohort Study

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Background Dependence increases the likelihood of adverse consequences of cannabis use, but its aetiology is poorly understood.

Aims To examine adolescent precursors of young-adult cannabis dependence.

Method Putative risk factors were measured in a representative sample ($n=2032$) of secondary students in the State of Victoria, Australia, six times between 1992 and 1995. Cannabis dependence was assessed in 1998, at age 20–21 years.

Results Of 1601 young adults, 115 met criteria for cannabis dependence. Male gender (OR=2.6, $P<0.01$), regular cannabis use (weekly: OR=4.9; daily: OR=4.6, $P=0.02$), persistent antisocial behaviour (linear effect $P=0.03$) and persistent cigarette smoking (linear effect $P=0.02$) independently predicted cannabis dependence. Neither smoking severity ($P=0.83$) nor persistent psychiatric morbidity (linear effect $P=0.26$) independently predicted dependence. Regular cannabis use increased risk only in the absence of persistent problematic alcohol use.

Conclusions Weekly cannabis use marks a threshold for increased risk of later dependence, with selection of cannabis in preference to alcohol possibly indicating an early addiction process.

Declaration of interest None.

Half to two-thirds of young adults in the UK, the USA, New Zealand and Australia have used cannabis recreationally (Webb *et al*, 1996; Fergusson & Horwood, 2000; Coffey *et al*, 2002; Johnston *et al*, 2002). Most have used it infrequently without health consequences, but a minority progress to harmful heavy use (Fergusson & Horwood, 1997). Adverse consequences include accidental injury, educational and legal difficulties, mental health problems and respiratory effects beyond those attributable to tobacco use alone (Ameri, 1999; Hall & Babor, 2000; Taylor *et al*, 2000; Johns, 2001; Ashton, 2002). Cannabis dependence is increasingly recognised as a further consequence of heavy use, with a lifetime risk in ever-users of about 10% (Anthony *et al*, 1994). The development of dependence probably prolongs use and increases the potential for harm (Ashton, 2002). Increasing use of more effective methods of drug delivery and increasing drug potency may underlie the development of dependence, but other contributing factors remain little explored (Hall & Babor, 2000). An understanding of the adolescent antecedents of dependence can inform the extent to which substance exposures increase risks for dependence as opposed to other factors such as intercurrent emotional or behavioural disorders (Fergusson & Horwood, 2000).

METHOD

Procedure and sample

Between August 1992 and December 1998 we conducted a seven-wave cohort study of adolescent health in Victoria, Australia. The cohort was defined using a two-stage sampling procedure in which we selected two classes at random from each of 44 government, Catholic and independent schools (total number of students 60 905). School retention rates to year nine in the year of sampling were 98%. One class from each school entered the cohort in the latter part of the ninth school year (wave 1) and the second class 6 months later, early in the tenth year (wave 2). Participants were subsequently reviewed at a further four 6-month intervals during their teens (waves 3 to 6) with a final follow-up at the age of 20–21 years (wave 7), 3 years after the final school year (Fig. 1).

Adolescent phase: waves 1 to 6

Altogether, 1947 adolescents (96% of the intended sample) participated at least once during waves 1 to 6, with a gender ratio (males 48.6%) similar to that in Victorian schools at the time of sampling (Australian Bureau of Statistics, 1993). Surveys were self-administered at school using laptop computers, thereby allowing the use of branched questions. Participants unavailable for follow-up at school completed the questionnaire by telephone.

Young-adult survey (wave 7, 1998)

The young-adult survey was carried out by telephone using computer-assisted interviews consistent with the adolescent phase. A total of 1601 young adults (82% of cohort participants; mean age 20.7 (s.d.=0.5) years, 46.0% male) were interviewed between April and December 1998. All analyses are based on this subset. Reasons for non-participation at wave 7 were: refusal ($n=152$); person traced but non-contactable ($n=59$); person not traced (lost) ($n=133$); and death ($n=2$). Of the 1601 participants interviewed, 71%, 27% and 3% respectively lived at home, with others or alone; 82% had completed the final school year; 85% had commenced post-school study, with 68% still studying at the time of the interview; 82% were in paid employment; 8% were neither studying nor employed.

Characteristics of non-completers at wave 7 were examined in a multivariate logistic regression model. Males were over-represented (odds ratio (OR)=1.9, 95% CI 1.5–2.4), as were those who had experienced parental divorce or separation (OR=1.8, 95% CI 1.4–2.5) and those reporting daily smoking at study inception (OR=2.1, 95% CI 1.5–2.9).

Outcome measure: DSM–IV cannabis dependence

A DSM–IV diagnosis of dependence required evidence that, within the previous
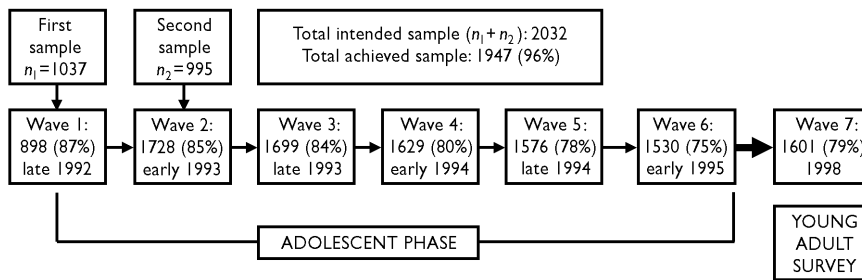
Fig. I Participation rates of 2032 secondary school students in the Victorian Adolescent Health Cohort Study.

12 months, an individual continued cannabis use despite significant substance-related problems (American Psychiatric Association, 1994), supported by endorsement of three of the following seven criteria: tolerance to the effects of cannabis; withdrawal symptoms on ceasing or reducing use; cannabis 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 reduced or given up owing to cannabis use; and use continued despite knowledge of physical or psychological problems induced by cannabis (American Psychiatric Association, 1994).

To generate the DSM–IV criteria for a diagnosis of cannabis dependence, the Composite International Diagnostic Interview 2.1, 12-month version (CIDI; Hall *et al*, 1999), was administered. We assessed cannabis dependence only in participants reporting weekly cannabis use in the preceding 12 months, to minimise responder fatigue. We considered that a diagnosis of cannabis dependence was consistent only with regular cannabis use, given the DSM–IV description of substance dependence as occurring with a 'pattern of repeated [substance] self-administration' (American Psychiatric Association, 1994).

Population prevalence estimates for cannabis dependence and dependence symptoms in the cohort at wave 7 have been reported earlier (Coffey *et al*, 2002). We estimated that 7% of the cohort, equivalent to 13% of ever-users, met criteria for DSM–IV cannabis dependence within the preceding 12 months. The most prevalent symptoms were persistent desire or unsuccessful abstinence attempts (10%) and unintentional use (8%). Tolerance (2%) and social consequences of use (1%) were the least prevalent symptoms. Eleven wave 7 participants did not report on their cannabis use and were classified as non-users for all analyses.

Measures: waves I to 6

Demographic variables

Gender and country of birth were recorded at study entry. Parental partnership status was assessed throughout the study.

Cannabis use

Cannabis use during the previous 6 months was assessed using the following rating scale: never used; not used in the past 6 months; a few times; monthly; weekly; daily. Those reporting the use of cannabis at least a few times in the past 6 months were classified as 'any users'.

Cigarette smoking

Participants reporting that they had smoked on 6 or 7 days in the previous week were categorised as daily smokers. Occasional smoking was defined as reporting smoking in the past month, but on fewer than 6 days in the past week.

Alcohol consumption

Participants reporting that they had drunk alcohol in the week before the survey completed a 1-week retrospective alcohol diary (specifying beverage and quantity), allowing derivation of two measures of problematic alcohol consumption: 'frequent drinking' on 3 or more days in the previous week, and 'high-dose drinking' with an average consumption of 5 units or more of ethanol per drinking day (1 unit is equivalent to one standard drink containing 9 g ethanol).

Antisocial behaviour

Ten items from the Moffitt & Silva (1988) self-report Early Delinquency Scale assessed antisocial behaviour relating to property damage, interpersonal conflict and theft in the previous 6 months. Antisocial behaviours were categorised according to whether more than one behaviour was endorsed 'more than once', in order to distinguish participants with more-global antisocial behaviours.

Psychiatric morbidity

A computerised form of the Clinical Interview Schedule (CIS) was used to quantify the severity of psychiatric morbidity (Lewis *et al*, 1992). Scores greater than 11 were taken to indicate psychiatric morbidity, reflecting the level at which clinical intervention is appropriate.

Explanatory variables: waves I to 6

Responses on adolescent risk factors (waves 1 to 6) were summarised as follows:

(a) The number of waves in which a condition was reported. It was necessary to collapse small categories, so we reclassified into four levels: none, one wave (indicating experimentation), two or three waves (indicating moderate exposure), and four to six waves (indicating persisting exposure and implying early onset, that is, the behaviour was necessarily reported at least by wave 3). This categorisation was applied to any cannabis use, any cigarette smoking, frequent alcohol use, high-dose alcohol use, antisocial behaviour and psychiatric morbidity.

(b) The maximum level reported during the six waves of follow-up for cannabis use (none, occasional, weekly, daily) and cigarette smoking (none, less than daily, daily).

Missing waves of data collection: waves I to 6

Seventy-five per cent of the cohort completed five of the first six waves of data collection, but owing to the staged recruitment, 54% of observations were missing from the first wave (Fig. 1). Missing observations for waves 2, 3, 4, 5 and 6 were 11%, 13%, 16%, 19% and 21% respectively. Overall, 59% of participants missed at least one wave. Multiple imputation was used to handle this fact, enabling summary measures to be defined for each participant in each of five 'completed' data-sets. Imputation was performed using the multivariate mixed effects model of Schafer & Yucel (2002).

Data analysis

Logistic regression analyses were performed on the binary outcome of cannabis dependence. In multivariable models, exposure

Table I Estimated frequency of time-varying adolescent measures and their association with cannabis dependence at age 20 years (n=1601): odds ratios (OR) from univariate logistic regression models

Adolescent measure: waves I to 6	Category	Estimated frequency		Cannabis dependence at age 20 years		
		n	95% CI	OR	95% CI	*P*
Maximum frequency						
Cannabis use	None	1083	1046–1120	I		<0.01[1]
	Less than weekly	332	299–364	4.7	2.7–8.2	
	Weekly	127	106–149	20	11–35	
	Daily	59	43–75	23	11–47	
Cigarette smoking	None	831	790–871	I		<0.01[1]
	Less than daily	401	366–435	4.3	1.9–9.6	
	Daily	370	336–403	13	6.8–23	
Persistence						
Any cannabis use	None	1083	1046–1120	I		<0.01[1]
	I wave	140	114–166	3.9	1.8–8.2	
	2 or 3 waves	151	126–177	6.2	3.2–12	
	4 to 6 waves	227	198–255	17	9.9–27	
	Linear effect[2]			2.5	2.1–2.9	
Any cigarette smoking	None	831	790–871	I		<0.01[1]
	I wave	171	145–197	2.2	0.70–7.0	
	2 or 3 waves	186	158–214	4.5	2.0–10	
	4 to 6 waves	413	378–448	13	6.8–24	
	Linear effect[2]			2.3	2.0–2.8	<0.01
High-dose alcohol use	None	890	850–931	I		<0.01[1]
	I wave	308	275–342	3.5	1.7–7.1	
	2 or 3 waves	276	246–306	5.6	2.8–11	
	4 to 6 waves	126	105–148	10	5.2–20	
	Linear effect[2]			2.1	1.7–2.6	<0.01
Frequent alcohol use	None	1358	1328–1387	I		<0.01[1]
	I wave	162	135–188	2.5	1.3–4.5	
	2 or 3 waves	71	54–88	2.7	1.1–6.8	
	4 to 6 waves	11	4–17	4.0	0.80–20	
	Linear effect[2]			1.8	1.3–2.3	<0.01
Psychiatric morbidity (CIS score > 11)	None	857	808–905	I		
	I wave	245	202–288	1.6	0.84–3.1	0.03[1]
	2 or 3 waves	272	241–302	1.8	0.84–3.7	
	4 to 6 waves	228	199–257	2.1	1.1–3.8	
	Linear effect[2]			1.3	1.1–1.5	<0.01
Two or more antisocial behaviours	None	1300	1269–1331	I		<0.01[1]
	I wave	153	130–177	3.7	2.1–6.6	
	2 or 3 waves	104	83–124	5.8	3.2–11	
	4 to 6 waves	44	29–59	11	5.2–25	
	Linear effect[2]			2.3	1.9–2.8	<0.01

CIS, Clinical Interview Schedule.
1. Wald test of null hypothesis of no difference in the frequency of cannabis dependence across categories.
2. Across the four categories of 'never', 'I wave', '2 or 3 waves' and '4 to 6 waves'.

effects were estimated as linear trends in the log odds ratio across ordered categories of exposure on explanatory variables. Two-tailed *P* values are reported based on Wald tests.

All analyses were performed using Stata 7.0 for Windows (Stata, 2001). We used the method of Rubin (1987) for creating valid inferences with the multiple imputation model, by combining over standard analyses performed on each of the imputed data-sets. Software for facilitating these analyses was written in Stata (details available from the authors upon request).

Ethical approval

Ethical approval for the study was obtained from the Royal Children's Hospital Ethics in Human Research Committee. Written parental consent was obtained at study inception and individuals gave informed verbal consent before commencing the wave 7 interview.

RESULTS

Young-adult cannabis dependence

Of 1601 young-adult participants, 936 (66% of males; 52% of females) interviewed in wave 7 reported ever using cannabis and 115 (7% of wave 7 participants) met criteria for DSM–IV cannabis dependence within the past 12 months. Participants with cannabis dependence were less likely to be female (10.3% of males and 4.5% of females; OR=0.41, 95% CI 0.27–0.61). Individuals of Australian birth (OR=2.5, 95% CI 1.1–5.4), with parental divorce or separation (OR=1.7, 95% CI 1.1–2.6) and neither studying nor employed (OR=2.9, 95% CI 1.7–4.9) were at increased risk of dependence.

Overall, 32% (95% CI 30–35) of the 1601 wave 7 participants reported cannabis use in the adolescent waves 1–6. Eighteen per cent (95% CI 14–21) of wave 1–6 users and 32% (95% CI 25–39) of those reporting at least weekly use later met criteria for cannabis dependence. Conversely, of the 115 with cannabis dependence at wave 7: 17% (95% CI 10–25) reported occasional use in waves 1–6; 22% (95% CI 10–34) weekly use; 38% (95% CI 27–49) daily use; and 22% (95% CI 14–30) initiated cannabis use after wave 6.

Univariate associations between young-adult cannabis dependence (wave 7) and adolescent exposures (waves 1–6)

The frequencies of a range of adolescent factors were estimated and crude associations between these and cannabis dependence were assessed (Table 1).

Maximum frequency of cannabis use and cigarette smoking

Maximum frequency of cannabis use in waves 1–6 showed strong association with

cannabis dependence in wave 7, with both weekly and daily maximum use carrying about a 20-fold increase in odds, indicating evidence of a threshold at weekly use. There was a strong increase in frequency of dependence with increase in maximum frequency of cigarette smoking from occasional to daily.

Persistence of adolescent behaviours

Strong associations, with evidence of linear relationships, were observed for the number of waves in which cannabis use, cigarette smoking, high-dose drinking and antisocial behaviour were reported, with a two-fold or greater average odds increase with each increase in level of reporting frequency. For all four measures the most persistent levels carried elevated odds of ten-fold or greater. A weaker association, but still with some evidence of a linear relationship, was observed with the number of waves in which psychiatric morbidity was identified, with an average increase in odds of 1.3 with increasing level of reporting frequency. With frequent drinking the clearest difference was between 'none' and 'some', with weak evidence for a dose-related effect.

Independent associations between young-adult cannabis dependence (wave 7) and adolescent exposures (waves 1–6)

We used multiple logistic regression to quantify the independent predictive associations and to adjust for possible confounding. To aid parsimony, measures of persistence (all of which showed univariate linear relationships) were entered in the multivariate model as linear effects. After adjustment, the only adolescent measures (apart from gender) demonstrating an independent relationship with cannabis dependence were: maximum frequency of cannabis use; and the number of waves in which each of cigarette smoking and antisocial behaviour were reported (Table 2). There was no evidence of first-order interaction effects between gender and any explanatory variable.

The relationship between cannabis dependence and persistent frequent drinking in adolescence changed direction, from a risk association in the univariate model to a protective association in the adjusted model. We therefore examined the interaction between this factor and maximum cannabis use, adjusting only for factors influential in the multivariate model reported

in Table 2. We selected individuals reporting frequent drinking in two or more waves, and identified evidence of an interaction between this characteristic and maximum weekly or daily cannabis use (Wald χ^2 $P=0.01$). Elevated risk for later dependence associated with maximum weekly or daily cannabis use was evident only in participants not reporting frequent drinking in two or more waves (OR=7.4, 95% CI 3.9–14; $P<0.01$). There was no evidence that those reporting both weekly or daily cannabis use and multiple waves of frequent drinking were at risk of later cannabis dependence (OR=1.2, 95% CI 0.28–5.0; $P=0.81$).

Confounding by cigarette smoking and antisocial behaviour on the effect of early-onset cannabis use

The reason for a lack of independent association between cannabis dependence and early cannabis use was explored in three further models. We characterised individuals who reported using cannabis in the first three waves of follow-up, i.e. in year 9 or year 10 (average 359 of a total of 517 users in waves 1 to 6). We compared

the association of early use *v.* later onset only in young adult participants reporting any adolescent use, progressively adjusting for the persistence of smoking and antisocial behaviour (Table 3). Both cigarette smoking and antisocial behaviour confounded the effect of early cannabis use. Persistent cigarette smoking showed the greater confounding effect, particularly when reported in four or more waves, that is, with early onset. After adjusting for these factors there was no evidence of an independent association between early cannabis use and later dependence.

DISCUSSION

Almost 60% of a representative sample of young adults aged 20–21 years in Victoria, Australia, reported ever having used cannabis and 7% met DSM–IV criteria for cannabis dependence in the 12 months prior to survey. Progression to dependence was common, in that one in five adolescent users were later classified as dependent in young adulthood. Weekly cannabis use was an even stronger predictor, with one in three meeting the criteria for dependence.

Table 2 Independent predictive associations between background and adolescent time-varying factors and cannabis dependence at age 20 years: odds ratios (OR) from multiple logistic regression

Adolescent measure: waves 1 to 6	Category	Cannabis dependence at age 20 years		
		OR	95% CI	P
Background factors				
Female gender		0.38	0.22–0.66	<0.01
Australian birth		2.0	0.82–4.8	0.13
Parental divorce/separation		1.0	0.63–1.72	0.87
Maximum frequency of use				
Cannabis use	None	1		0.02[1]
	Less than weekly	1.7	0.59–4.7	
	Weekly	4.9	1.3–19	
	Daily	4.6	1.0–21	
Cigarette smoking	None	1		0.83[1]
	Less than daily	0.73	0.18–3.0	
	Daily	0.71	0.13–3.8	
Persistence				
Any cannabis use	Linear effect[2]	1.1	0.70–1.7	0.71
Any cigarette smoking	Linear effect[2]	1.9	1.1–3.2	0.02
Frequent alcohol use	Linear effect[2]	0.69	0.46–1.0	0.07
High-dose alcohol use	Linear effect[2]	1.1	0.81–1.5	0.55
Psychiatric morbidity	Linear effect[2]	1.1	0.91–1.4	0.26
Two or more antisocial behaviours	Linear effect[2]	1.3	1.0–1.7	0.03

1. Wald test of null hypothesis of no differences in the frequency of cannabis dependence across categories.
2. Across the four categories of 'never', '1 wave', '2 or 3 waves' and '4 to 6 waves'.

Table 3 Secondary analysis of the association between early cannabis uptake and cannabis dependence in adolescent cannabis users ($\bar{n}$=517), showing the effect of adjusting for the number of waves of cigarette smoking and antisocial behaviour: odds ratios (OR) from univariate and multivariate logistic regression models

Adolescent measure (waves 1 to 6)	Association with cannabis dependence at age 20 years							
	Unadjusted		Adjusted for smoking		Adjusted for antisocial behaviour		Adjusted for smoking and antisocial behaviour	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Any cannabis use in waves 1 to 3 ($\bar{n}$=359)	2.1	1.1–4.0	1.7	0.85–3.3	1.8	0.95–3.6	1.4	0.70–2.9
Cigarette smoking								
None			1				1	
1 wave			1.3	0.35–4.8			1.2	0.31–4.4
2 or 3 waves			1.8	0.63–5.3			1.8	0.61–5.1
4 to 6 waves			2.9	1.1–7.2			2.7	1.1–7.0
Antisocial behaviour								
None					1		1	
1 wave					1.8	1.0–3.5	1.9	1.0–3.6
2 or 3 waves					2.2	1.1–4.4	2.2	1.1–4.5
4 to 6 waves					4.0	1.7–9.2	3.8	1.7–8.7

$\bar{n}$, mean n.

Additional predictors were male gender, early and persistent cigarette smoking, and early and persistent antisocial behaviour. In contrast, regular drinking in the teenage years appeared protective against cannabis dependence.

Cannabis dependence was assessed at an age of peak cannabis use in a close-to-representative sample with high participation into young adulthood. To circumvent bias from non-response during the adolescent waves, multiple imputation of missing covariate values was performed using a model based on background measures (available for 96% of the sampling frame). This allowed us to define exposure measures of time-varying adolescent behaviours based on all six waves of data collected in the adolescent phase for all 1601 participants who were interviewed in wave 7 aged 20–21 years.

A potential study limitation was the underspecification of cannabis dependence. First, although the response rate in wave 7 was high, differential under-ascertainment of illicit substance users – a notoriously difficult group to reach – might have occurred. Second, as a third of young adult cannabis users had commenced using only in the preceding 3 years (that is, since wave 6), it is likely that some currently non-dependent participants would develop cannabis dependence in the next few years (Rosenberg & Anthony, 2001). We have assumed that the risk profile for cannabis dependence in our sample would be the same for all members of the cohort, but these possible sources of error could result in attenuation of the observed associations.

In defining adolescent measures of smoking we elected not to distinguish between persistent occasional smoking and daily smoking. This decision was taken to aid parsimony and was supported by the similarity in risk association of occasional and daily smoking in the adjusted model describing cannabis dependence. We assessed persistence only in problematic alcohol use, as 'any' alcohol use was too common to be informative.

Predictors

Gender

Males were marginally more likely than females to use cannabis overall, but the transition to dependence was considerably more likely in males. We found no evidence of effect modification by gender, indicating that some underlying unmeasured factors were responsible. The suggestion that gender differences might be due to differing opportunity rather than differing transition rates is not supported by our findings (Van Etten & Anthony, 2001).

Adolescent cannabis use, antisocial behaviour and cigarette smoking

Early initiation of cannabis use, often preceded by antisocial behaviour and cigarette smoking, is generally accepted as an important predictor of escalation in drug use (Fergusson & Horwood, 1997, 1999). Although we found that early cannabis uptake predicted later dependence in the crude analysis, cigarette smoking and antisocial behaviour largely accounted for this effect in the adjusted model. Furthermore, as no dose effect was evident with frequency of cigarette smoking, our findings are consistent with the suggestion of Bierut et al (1998) that daily smoking is not a specific marker for an underlying vulnerability to cannabis dependence. This nonspecific association with cigarette smoking probably reflects the social environment in which both activities occur, rather than individual biological susceptibility.

Why does early deviant behaviour predict cannabis dependence? It is possible that the prolonged cannabis exposure that often accompanies early deviant behaviour might bring forward the transitions from occasional use to regular use and thence to dependent use evident in our young adult sample. If this is so, the effect could moderate as the cohort ages, because older initiators might make the transition to dependence later.

The threshold of risk that we observed with weekly cannabis use indicates that it is the transition to regular use that provides sufficient drug exposure in the development of early dependent use. The slow metabolism of cannabis results in the persistence of measurable physical and psychological changes well beyond the duration of the

subjective effects (Ameri, 1999). The maintenance of a low but stable frequency of intake might be sufficient to produce long-lasting neuro-adaptive changes thought to be associated with the 'drug-wanting, seeking and taking' process which occurs with the initiation of addictive behaviour (Hyman & Malenka, 2001). Interestingly, out-of-control use early in the cannabis-using career has been reported to distinguish individuals who make the transition to dependence from non-dependent users, supporting the notion of an early biological response (Rosenberg & Anthony, 2001).

Adolescent alcohol use

An apparently counterintuitive finding was that persistent frequent alcohol use as a teenager negated the risk of developing cannabis dependence in regular cannabis users. It is well established that problematic adolescent alcohol use is one of the constellation of behaviours associated with cannabis initiation (e.g. Donovan & Jessor, 1985), but our findings indicate that a different picture emerges, with escalation of use in the transition between adolescence and adulthood. This reflects the divergence in criminality in the transition to young adulthood observed in early drug users compared with adolescent alcohol users identified by Newcomb & Bentler (1988: pp. 102–119). Our findings may therefore illustrate a social process whereby individuals select into either a predominantly alcohol-using or a cannabis-using lifestyle. From the physiological perspective, preferential cannabis use as an early indication of dependence is consistent with a substance-specific biological susceptibility to addiction (Hyman & Malenka, 2001). Selective regular cannabis use during adolescence may mark a neurophysiological and psychological precursor of dependence.

Adolescent psychiatric morbidity

Although cannabis use has been linked with increased rates of depression and anxiety cross-sectionally (Johns, 2001), we did not find that adolescent psychiatric morbidity independently predicted cannabis dependence. This observation argues against self-medication as a mechanism for continuing problematic cannabis use beyond the teenage years and is consistent with earlier findings (McGee et al, 2000). Conversely, we have reported separately that regular cannabis use in adolescence predicts

CLINICAL IMPLICATIONS

■ Progression from adolescent cannabis use to dependence in young adulthood is common.

■ Adolescent weekly cannabis use marked a threshold of risk for later dependence, particularly in the absence of persistent frequent alcohol use.

■ Self-medication did not appear to mediate the escalation of cannabis use in the transition from adolescence to young adulthood.

LIMITATIONS

■ Missing observations during the adolescent phase of follow-up might have biased estimates of time-varying exposures.

■ Differential loss to follow-up of illicit substance users in the young-adult phase might have occurred.

■ Cannabis dependence might have been underspecified, resulting in attenuation of observed associations.

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later psychiatric morbidity in young women (Patton et al, 2002).

Implications

Hall & Babor (2000) pointed out that we have not yet adequately explored the pathophysiological consequences of cannabis use – a process that took many years with tobacco and eventually led to broad-ranging policies aimed at reducing consumption. The recent reclassification of cannabis from a class B drug to a class C drug by the Home Office in the UK in part reflects a view that cannabis use poses a lesser public health problem than use of other illicit substances. The lethality and withdrawal severity of cannabis may indeed differ from other drugs, but its use is far more common (Hall et al, 1999; Johnston et al, 2002). As well as the increasing prevalence of cannabis use in young people, the transition rate to dependence would appear to be increasing, with concomitant personal, social and physical harms resulting from prolonged heavy use and addictive behaviour (Hall & Babor, 2000; Ashton, 2002). In 1990–1992 it was estimated that 9% of ever-users were at life-time risk of dependence (Anthony et al, 1994) but more recent estimates report that between 13% and 16% of users are at risk by their early 20s (Poulton et al, 1997; Fergusson & Horwood, 2000; Coffey et al, 2002). The case for a more concerted public health response seems strong.

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