

The psychological and social sequelae of illicit drug use by young people:
Systematic review of longitudinal, general population studies.

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Abstract

Illicit drug use by young people is widespread and is associated with several types of psychological and social harm. Such a relation may not be causal. Correlations may arise because both drug use and adverse psychological and social outcomes share common antecedents. Alternatively, the way both drug use and harm are measured may lead to biased non-causal estimates of associations between the two. A systematic review was undertaken to identify longitudinal evidence relating drug use by young people in the general population to subsequent harm. Most evidence identified related to sequelae of cannabis use. Relatively consistent associations were apparent between cannabis use and lower educational attainment, greater reported use of other illicit drugs and higher reporting of psychological symptoms. All these associations appeared explicable in terms of non-causal mechanisms. Possible mechanisms for true causal relations included neuro-hormonal pathways and the legal status of cannabis. Since cannabis use appears widespread it is important to clarify these questions, and to generate evidence on the public health impact of use of other drugs.

Background

The use of illicit drugs amongst young people appears to be widespread and may be increasing.^{1 2} Drug use can be associated with significant harm.^{3 4 5} However the causal basis of these associations is sometimes unclear. Most users of illicit drugs do not appear to use drug treatment services and the public health importance of harm caused by drug use is difficult to infer using evidence from clinical samples. Concerns over psychological and social (as opposed to physical) health consequences of drug use by young people have been prominent; particularly in relation to cannabis, which appears to be the most widely used illicit drug.⁶ Opinions regarding the probable importance of these, in public health terms, have varied.^{7 8 9} We conducted a systematic review of general population, longitudinal studies relating illicit drug use by young people to subsequent psychological and social harm.

Search strategy and selection criteria

The general electronic databases Medline, Embase, Cinahl, Psyclit and Web of Science and the specialist databases of the Lindesmith Center, Drugscope, NIDA/SAMHSA and Addiction Abstracts were searched using an agreed battery of search terms (available on request) in July 2000, this search was updated in July 2001. Addiction Abstracts was hand-searched for the period not covered by the electronic database (1994-1996). 163 key individuals in the addictions field (details available on request), identified through personal contacts and from official sources were asked to identify evidence unlikely to be identified from the above sources (such as unpublished data or data published only in books). Both published and unpublished evidence along with that not published in English (which was translated) was considered.

All prospective studies based in the general population that measured use of any illicit drug by individuals aged 25 or younger at the time of use and related this to any measure of psychological or social harm assessed subsequently were included. Two reviewers assessed methodological quality of included studies independently. Quality criteria used related to sample size and representativeness, age of sample at initiation, length and completeness of follow up, validity and reliability of exposure and outcome measures and degree of adjustment for potential confounding factors. Reviewers then discussed which studies merited detailed critical appraisal of their results, based on these criteria. Corresponding authors on papers deriving from studies felt to merit detailed consideration were contacted and asked to supply any relevant unpublished data. Database searches were repeated in June 2003.

Results

46 longitudinal studies identified in initial searches in 2000, reported associations between drug use by young people and psychological or social outcomes. Five studies identified were only published in languages other than English. All studies identified used an observational design. All had published results in peer-reviewed journals, however some additional publications in books and unpublished papers were identified through personal contact. Many studies reported sequelae of composite measures of illicit drug use such that inferring effects of specific drugs was impossible. Many studies reported substantial losses to follow-up and made either no, or minimal, attempt to adjust estimates for possible confounding factors. 30 of the 46 studies were judged to be of limited use in clarifying causal relations based on evidence currently available from them (results summarised in Table 1).

16 studies were judged to warrant more detailed examination (summarised in Table 2.). All were published in English; none were from the UK. Their primary focus was sequelae of cannabis use. Most studies were of young people recruited through schools^{3 10 11 12 13 14 15 16 17}, although some were sampled from population registers^{18 19 20} and one was based on military conscripts.²¹ Two studies from New Zealand followed cohorts of children born in a particular area from birth or soon after till early adulthood.^{22 23} One study was based on adult follow-up of a perinatal cohort.²⁴ In all studies illicit drug use was measured through uncorroborated self-report. Though some measures were similar across studies, no two studies measured either illicit drug exposure or psychosocial outcome in the same way. In addition, potential confounding factors were inconsistently assessed across studies. Because of

these considerations, quantitative synthesis of results across studies (meta-analysis) was felt likely to be misleading and was not attempted.²⁵

GENERAL NOTES

Estimates (along with 95% confidence intervals and/or “p” values where available) as reported in the individuals studies are given. Where both adjusted and unadjusted estimates were reported these are both given. Adjustment factors for individual estimates are not given. Measures available are described in table 2, however adjustments did not necessarily include the full range of available measures. Only three studies had any details relating to early life (i.e. before age 5) problems and environment that were measured contemporaneously (and therefore not subject to recall bias).^{22 23 24}

CANNABIS USE AND EDUCATIONAL ATTAINMENT

Cannabis use was associated with lower educational attainment in several studies. Two studies presented odds ratios for school “dropout” according to cannabis use both before and after adjustment for potential confounding factors. In the Christchurch Study (New Zealand) cannabis use prior to age 15 was associated with an odds ratio for dropout of 8.1 (4.3-15.0) that on adjustment was attenuated to 3.1 (1.2-7.9).²² In “Project Alert” (North America) each single point increase on a cannabis use scale was associated ($p<0.001$) with a crude odds ratio of 1.68 for dropout, however adjustment attenuated this to 1.13, an estimate reported as “not significant”.¹³ In the same study the crude and adjusted odds ratios for dropout associated with tobacco use were 1.85 and 1.37 (both $p<0.001$). The South Eastern Public Schools study (North America) also related cannabis use to school dropout

though only reported adjusted estimates.¹¹ Individuals reporting initiation of cannabis use by age 16, 17 or 18 had an adjusted odds ratio for dropout at the same age of 2.31, $p < 0.01$ overall. In the Los Angeles schools study early adolescent drug (including cannabis) use was associated with lower self-reported college involvement in later adolescence (adjusted path coefficient -0.19 , $p < 0.05$).³

CANNABIS USE AND USE OF OTHER DRUGS

The “Gateway” theory, proposing an orderly temporal progression from licit drugs, through cannabis use to other illicit drug use arose out of the New York Schools study.^{15 26} 85% of men and 83% of women reporting drug use reported this pattern. Other studies identified found that individuals who reported more drug use in adolescence also reported more drug use in later life, however specific causal relations between use of one drug and subsequent increased risk of use of another could not be inferred from their composite data.^{14 27}

Few studies were able to fully address the issue that associations between use of one drug (such as cannabis) and use of others may simply reflect confounding by a general propensity to try illicit drugs.²⁸ Three studies attempted to address this through adjustment for early life factors that might underlie such a propensity or other measures (such as use of licit drugs) that might be related to it. Amongst Swedish military conscripts who reported that cannabis was their most used illicit drug (compared to those reporting no illicit drug use) there was a crude odds ratio of 6.8 (4.9-9.4) for later injection drug use.²⁹ The adjusted odds ratio was 3.3 (1.9-5.9). In the East Harlem study (North America) individuals whose reported adolescent cannabis use fell in the top frequency quartile were more likely to report other illicit

drug problems in early adulthood though this association was weak (adjusted odds ratio 2.69 (0.60-12.16)).¹²

The Christchurch study incorporated the most detailed measures of potential confounding factors.³⁰ Weekly cannabis users had a crude relative risk of reporting other drug use of 142.8 (92.3-222.9) compared to those reporting no cannabis use. Adjustment attenuated this estimate considerably though it remained substantial at 59.2 (36.0-97.5). Even those reporting use of cannabis on only one or two occasions annually still appeared to have a three-fold increased risk of using other drugs (adjusted relative risk 2.8 (2.4-3.1)).

CANNABIS USE AND PSYCHOLOGICAL HEALTH

Several studies related cannabis use to symptoms of low mood and depression (including reported thoughts and acts of self-harm), anxiety symptoms and psychotic symptoms. One study related cannabis use to a clinical diagnosis of schizophrenia ascertained from hospital records. In the Christchurch study reports of anxiety, depression and suicidal ideas were all increased in individuals reporting cannabis use prior to age 15 though none of these associations were either strong or substantial, particularly following adjustment for possible confounding factors.²² Similar patterns of association were reported in relation to frequency of cannabis use in late adolescence and rates of reported mental disorders during the same period.³¹ Ideas and reported acts of self-harm were increased in early adolescence amongst individuals reporting a higher frequency of cannabis use in early adolescence in the Christchurch study.³²

The Children in the Community study (North America) also reported weak and insubstantial increased risk of reported mental disorder in late adolescence amongst those reporting cannabis use in early adolescence (e.g. odds ratio for depression 1.13 (0.95-1.34)).¹⁸ The Dunedin study (New Zealand) found that amongst males an unadjusted odds ratio of 3.59 for any reported mental disorder at age 21, amongst those reporting cannabis use at 18, was attenuated to 2.00 (1.29-3.09) on adjustment for potential confounding factors.³³ Amongst females this association was not apparent (adjusted odds ratio 0.75 (0.47-1.17)). Conversely a recent report from an Australian schools study (see table 1) suggests an association between cannabis use and mental disorder in females but not males.^{34 35} Daily cannabis at age 14-15 in females was associated with increased reporting of depressive symptoms at age 20-21 with an unadjusted odds ratio of 8.6 (4.2-18) (adjusted odds ratio 5.6 (2.6-12.0)); in males the corresponding estimates were 1.9 (0.93-3.8) and 1.1 (0.55 to 2.6).

Amongst Swedish military conscripts those reporting cannabis use on more than 50 occasions had a crude relative risk of 6.0 (4.0-8.9) for subsequent diagnosis of schizophrenia over 15 year follow-up, compared those reporting no cannabis use.²¹ After re-categorising frequency of use adjusted relative risk of schizophrenia associated with the highest exposure category (use on more than ten occasions) was 2.3 (1.0-5.3). Results of a later 27 year follow-up were similar (crude odds ratio for schizophrenia associated with use on more than 50 occasions 6.7 (4.5-10.0) attenuated to 3.1 (1.7-5.5) on adjustment).³⁶ The Dunedin study recently reported an association between cannabis use by age 15 and greater reporting of schizophrenic symptoms (rather than clinical schizophrenia) at age 26 (adjusted odds ratio 4.50 (1.11-18.21), both sexes combined).³⁷ Results appeared to be specific to schizophrenic - as opposed

to depressive – symptoms. Similar results have also been reported from the Christchurch study.³⁸ Cannabis dependence at age 18 was associated with a crude rate ratio for reporting psychotic symptoms of 2.3 (1.7-3.2), attenuated to 1.8 (1.2-2.6) on adjustment. Associations between cannabis use and psychosis have also been reported by a recent Dutch longitudinal study though this included individuals out-with the age range of our review.³⁹

Reported cannabis use in adolescence appeared to have no important direct association with later mental health in the Boston Schools study, the Los Angeles Schools study and the Woodlawn study (all North American).^{14 40 41}

CANNABIS USE AND ANTISOCIAL BEHAVIOUR

In the Christchurch study cannabis use prior to age 15 was associated with increased involvement in antisocial behaviour (unadjusted odds ratio for conduct disorder 7.0 (4.3-11.4), offending 5.7 (3.3-10.0) and police contact 4.8 (2.5-9.3)).²² Adjustment for potential confounding factors substantially attenuated all these associations (adjusted odds ratio for conduct disorder 1.0 (0.5-2.1), offending (0.6-2.7) and police contact 2.1 (0.9-4.8)). Annual frequency of reported cannabis use between ages 15-21 showed a positive association with reported involvement in property and violent crime, considerably stronger at younger ages.³² Unadjusted estimates were not reported; the adjusted risk ratio for criminal involvement associated with weekly cannabis use at age 15 was 3.7 (2.1-6.6) whereas at age 21 it was 1.7 (1.1-2.7).

In the “Adolescent Health” study (North America) reported frequency of cannabis use in early adolescence showed some association with reported involvement in violent

crime in late adolescence in both males and females (adjusted regression coefficients 0.007 and 0.004 respectively, both $p < 0.01$).⁴² In the East Harlem study reported frequency of cannabis use in early adolescence showed a positive association with several categories of reported “problem behaviour” in later adolescence.¹² Odds ratios were 2.00 (1.09-3.66) for self-reported lower level of education, 1.96 (1.03-3.73) for reported deviance, 3.61 (1.02-12.78) for greater number of sexual partners, 3.58 (1.22-10.55) for less condom use and 2.34 (1.07-5.15) for lower church attendance.

In a follow up of participants in the National Collaborative Perinatal Project (North America) reported frequency of cannabis use at age 24 was positively associated with reported offending at age 26 in both males and females (adjusted regression coefficients for reported violent offending 0.29, $p < 0.001$ and 0.15, $p < 0.05$ respectively).²⁴ A later report from this study reported similar results.⁴³ Similarly in the Pittsburgh Youth study, males in the top quartile of reported frequency of cannabis use at the preceding study assessment showed greater reporting of involvement in violent behaviour though this association was only strong in early adolescence (adjusted odds ratio for reported violence at 14 according to cannabis use at 13 3.1, $p < 0.01$).¹⁷ The Dunedin study reported cross-sectional associations between cannabis use and violence (self-report and official records of conviction) at age 21.⁴⁴ The unadjusted odds ratio for convictions and/or reported violence associated with cannabis dependence was 6.9 (4.1-11.4) (adjusted 3.6 (2.1-6.4)).

In contrast the “Children in the Community” study found reported drug (including cannabis) use in early adolescence to be negatively associated with reported delinquency in later adolescence in both males and females (adjusted path coefficients

-1.15, $p < 0.01$ and -1.13, $p < 0.001$ respectively).⁴⁵ Similarly in the Los Angeles schools study reported drug (including cannabis) use in early adolescence showed a negative association with reported involvement in violent crime and general criminal activity in later adolescence (adjusted path coefficients -0.17 and -0.22 respectively, both $p < 0.05$).³ In “Project Alert” reported drug use in early adolescence had no effect (actual estimates not reported) on reported incidence of violent behaviour in later adolescence.⁴⁶

CANNABIS USE AND THE TRANSITION TO ADULT ROLES

A diverse group of outcomes, principally related to employment and family formation, within this category were considered in some studies. In the “Children in the Community” study higher frequency of cannabis use in adolescence was associated with greater odds of being unemployed, (unadjusted odds ratio 1.81 (1.06-3.05) adjusted 1.74 (1.01-2.96)) of living outside the parental home (unadjusted odds ratio 1.92 (1.32-2.80) adjusted 2.21 (1.40-3.51)) and of being unmarried (unadjusted odds ratio 2.20 (1.51-3.19) adjusted 2.41 (1.57-3.75)) in early adulthood.⁴⁷ In the same study drug use (including cannabis use) frequency in adolescence was positively associated with greater work involvement in young adulthood (adjusted path coefficient 0.20, $p < 0.01$).⁴⁸ In the New York schools study, greater drug use (including cannabis use) in participants’ early 20s was associated with both more frequent job change and higher income in their late 20s (adjusted path coefficients 0.240, $p < 0.01$ and 0.129, $p < 0.05$ respectively).⁴⁹ The association with income had disappeared by participants’ mid 30s.

The Los Angeles schools study found that adolescent drug use had no effect on adult “social conformity” (a latent variable based on reported law abidance, liberalism and religious commitment).³ Adolescent drug use was positively associated with adult family formation (marriage and number of children) and perceived relationship importance (adjusted path coefficients 0.62 and 0.16 respectively, both $p < 0.05$). Adolescent drug use was again associated with more frequent young adult job change and higher income (adjusted path coefficients 0.16 and 0.06 respectively, both $p < 0.05$). The National Longitudinal Study of Youth (North America) reported no relation between frequency of adolescent cannabis use and young adult income.²⁰ This study did report that greater frequency of adolescent cannabis use amongst women was associated with increased risk of marriage to a problem-drinking spouse in adulthood (adjusted relative risk 2.04 (1.57-2.97)).⁵⁰

SEQUELAE OF OTHER ILLICIT DRUG USE

Few studies reported use of other illicit drugs in detail; generally only cross-sectional associations or effects of drug use in individuals aged 25 or above were described. In the Los Angeles schools study, frequency of adolescent cocaine use was positively associated with several indicators of psychological problems in adulthood (adjusted path coefficient for increased psychotic symptoms 0.10, $p < 0.05$, negative self-image 0.06, $p < 0.01$ and attempted self-harm 0.14, $p < 0.01$).⁴⁰ The Central Harlem Study found similar associations between adolescent cocaine use and young adult reporting of health problems however the use of a combined “psychophysical” health outcome scale did not allow specific associations with psychological health to be examined.¹⁹ This latter study was the only one to describe specific consequences of opiate use, though again these were reported in relation to the same psychophysical outcome

indicator.⁵¹ Similar to its findings in relation to adolescent cannabis use amongst women, the National Longitudinal Survey of Youth reported an association between greater frequency of adolescent cocaine use and increased risk of marriage to a problem-drinking spouse (adjusted relative risk 1.75 (1.24-2.46)).⁵⁰

A recent report from a German study (table 1) reported inconclusive cross-sectional associations between “ecstasy” use and mental health.^{52 53}

Discussion

A striking finding of this review was the lack of general population, longitudinal evidence on the sequelae of any illicit drugs other than cannabis. This finding probably reflects the fact that, at least till recently, use of drugs other than cannabis has been proportionately smaller and associated with a greater degree of social marginalisation. Thus these drug users were probably less likely to be recruited to and retained in the longitudinal studies reviewed.

Evidence of associations between cannabis use and some harm are consistent though the strength and magnitude of this association varies. The causal nature of these associations however appears less clear. Causal interpretations of these data compete with three basic alternatives; reverse causation, bias and confounding.

Psychosocial problems may be more a cause than a consequence of cannabis use, particularly with regard to associations between use and mental illness.⁶ Some studies adjusted for psychological symptoms reported at baseline or excluded incident problems occurring in early follow-up. Nevertheless, unreported or sub-clinical psychological problems may have preceded and precipitated cannabis use in some instances. Individuals with a pre-existing tendency to experience psychological difficulties may be more inclined to develop problematic patterns of drug use (for example depressed individuals are more likely to start smoking and less likely to stop).⁵⁴ Cannabis use may also have exacerbated existing predispositions to psychological problems.

Exposure to cannabis use and experience of psychosocial problems may have been associated with both recruitment and retention. This may have resulted in selection bias that might either inflate or diminish the apparent association between cannabis use and harm. Further in all studies, cannabis use was measured using uncorroborated self-report, in many it was related to similarly subjective outcomes. In this situation, spurious associations can arise.⁵⁵ Self-report of illicit drug use can be unreliable, particularly in general population studies where the drug-use status of participants is not previously apparent.⁵⁶ Depending on perceptions of social desirability individuals may under or over-report their use.⁵⁷ ⁵⁸ This tendency may extend to proscribed behaviour in general leading to an apparent, though non-causal, association between cannabis use and use of other drugs, and between cannabis use and proscribed behaviour.

Both cannabis use and adverse psychosocial outcomes appear to share common antecedents related to various forms of childhood adversity, peer-group and family factors.⁵⁹ ⁶⁰ ⁶¹ Thus, a “common cause” explanation may explain associations between cannabis use and several types of harm. In one sense, this is an example of confounding. The common cause is associated both with the exposure, cannabis use, and the outcome, psychosocial harm, but is not on the causal pathway between the two and thus confounds their apparent association. Arguably, all examples of confounding reflect common antecedents though exploration of this may be of limited value in most circumstances (Shaw’s famous comments about the “health conferring” benefits of wearing top hats and carrying umbrellas for example).⁶² However, attempts to understand the association between drug use and psychosocial harm could

be helped by consideration of the common causes that might underlie both these outcomes.

Adjustment for possible confounding factors was attempted in several studies, generally resulting in attenuation of estimates. The problem of identifying genuinely independent effects in the situation where correlated covariates are measured imprecisely, is well recognised.^{63 64} In most instances the measures available in these studies of both exposure and outcome were relatively imprecise. Indices of the early life adversity or other factors that might have confounded these exposure outcome associations were often, unavailable, similarly imprecise or measured retrospectively and hence potentially subject to recall bias.

Perhaps the strongest evidence against a simple causal explanation for associations between cannabis use and psychosocial harm relates to population patterns of the outcomes in question. For example, consider schizophrenia, an outcome that appears strongly associated with cannabis exposure over a reasonably short time period (relative risks of 4.0 to 5.0 reported over follow-up periods of 10-15 years).^{21 37} Cannabis use appears to have increased substantially amongst young people over the past 30 years, from around 10% reporting ever use in 1969-70 to around 50% reporting ever use in 2001.^{1 21} If the relation between use and schizophrenia were truly causal and if the relative risk conferred by use is 5.0 then the incidence of schizophrenia should have more than doubled since 1970. However population trends in schizophrenia incidence appear to suggest that incidence has been either stable or slightly decreased over the relevant time period.^{65 66} Such a picture would only be compatible with a truly causal relation between cannabis use and schizophrenia if

there were another factor conferring at least a five-fold increase in risk whose prevalence in the general-population had decreased since 1970 to a greater extent than cannabis use has increased. Such a scenario seems unlikely.

The above considerations suggest that a non-causal explanation is possible for most reported associations between cannabis exposure and both psychological and social harm. It is important to clarify the question of causality since cannabis use appears to be widespread.

A causal relation could plausibly be mediated through two principal pathways. Cannabis appears to influence neuro-hormonal processes, though whether this influence plausibly leads to the associations seen between cannabis use and, for example, lower educational attainment, is unclear.⁹ A social mechanism may also be involved. Using and purchasing cannabis may bring users into contact with criminal or anti-conventional culture and commerce. The latter may increase their risk of using other illicit drugs.⁶⁷ The former may increase their risk of lower educational attainment and subsequent experience of a range of unfavourable outcomes related to antisocial behaviour and the problematic transition to conventional adult roles.⁶⁸

Evidence on the public health effects of use of other illicit drugs is also needed. Contemporary birth cohort studies whose participants are currently in early adolescence are ideally placed to measure the use of illicit drugs using objective assays in addition to standardised self-report instruments.^{69 70} Though practical issues are pertinent to this there are essentially no additional ethical concerns other than those relevant to self-report alone.^{56 57 71} A key advantage of birth cohort studies is

their ability to consider the issue of common causes, discussed above. Prospective studies recruiting older individuals do not share this advantage. Even if they attempt to investigate common causes (and most appear not to) their ability to do so will be limited since the relevant measures are compromised by recall and other biases.

The general population birth cohort approach will probably be most useful in clarifying effects of cannabis and some stimulants, such as ecstasy, whose use does not appear to be concentrated amongst the socially marginalized. It will also be useful to compare effects of illicit drug use with those of licit drugs in the same population. Standardisation and objectivity where possible in outcome measures can also be sought, for example linkage to official records of health service and criminal justice system contact should be possible with consent. In relation to the latter, it will be interesting to assess the effects of criminal convictions, both drug-related and non drug-related, in participants who do and don't use drugs. Birth-cohort studies with detailed, contemporaneous measures of early life environment will be particularly valuable.⁷⁰

Effects of patterns of drug use more closely associated with social marginalisation, such as injection opiate use may be more difficult to study in general population birth-cohorts. Public health effects of this type of drug use may be more usefully studied in population-based cohorts of drug users recruited through primary care where comparison with non drug-using contemporaries in the same population is possible.⁴

Powerful evidence of particular relevance to policy, on true causal relations between drug use and psychosocial harm will come from the experimental evaluation of

interventions to reduce drug use. Investment in such interventions is considerable yet evidence for their effectiveness is limited.⁷² Further, unintended effects, such as increases in drug use, are not impossible. However a reduction in drug use, accompanied by a reduction in possibly drug-related harm, amongst individuals randomly allocated to receive a preventive intervention would be strong evidence in favour of a truly causal association between drug use and harm.

It is also important that the issue of psychosocial harm be separated from that of physical harm. We did not systematically review evidence on the effects of illicit drug use on physical health. Injection drug use is clearly associated with considerable physical health problems.⁴ Evidence also suggests that chronic, non-injection use of other drugs, including cannabis, is unlikely to be harmless to physical health. Though cannabis can be consumed in various ways it appears that the predominant mode of use involves smoking with tobacco.⁷³ Some users appear to limit their consumption to occasional use of small amounts and to abstain from use by middle adulthood.²⁶ Such use patterns may not be associated with significant health consequences. However, other users report daily use over several years and there is evidence that this pattern may extend into at least middle adulthood in some individuals.⁷³ The tobacco consumption alone associated with such use is likely to be harmful. Whether cannabis use has any additional effects is unclear, though some evidence suggests it may.^{74 75} It is interesting that in the early days of epidemiological research into effects of tobacco use, concerns over psychosocial, rather than physical, consequences were prominent.^{76 77} There is, as yet, only preliminary data on the long-term effects of cannabis use on physical health.⁷⁸ That these data currently suggest no important influence on mortality should be interpreted cautiously. Crude exposure measures are

likely to have diluted effect estimates in relation to outcomes with long latency periods. For example, in the same dataset, tobacco use appeared to have no influence on mortality.

Conclusions

Despite widespread concern, there is no strong evidence that use of cannabis has important consequences for psychological or social health. This is not equivalent to the conclusion that evidence suggests cannabis use is harmless in psychosocial terms. Problems with available evidence render it equally unable to support this latter proposition. Better evidence is needed in relation to cannabis, whose use is widespread, and in relation to other drugs that, though less widely used, may have important effects.

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Disclaimer

All views expressed are those of the authors and not necessarily of the Department of Health.

Table 1. Summary of studies identified in review but not discussed in detail in text. Studies listed in chronological order of relevant publications

Studies reporting outcomes related to general drug exposure	Subjects/ setting	Main relevant findings	Comments
Sadava 1973, Canada ⁷⁹	College “freshmen”	Low expectations of goal attainment and more “pro-drug” attitudes associated with drug problems.	Probable selection bias, limited adjustment for confounding, significance of outcome measures unclear
Annis 1975, Canada ⁸⁰	High school students.	Use of both licit and illicit drugs positively associated with school dropout from official records	No adjustment for confounding
Benson 1984 and 1985, Sweden ^{81 82}	Male military conscripts	Drug use associated with higher rates of criminality, health problems and mortality as ascertained from official records	Crude exposure measurement and no adjustment for confounding.
Friedman 1987, USA ⁸³	Volunteer high school students reporting drug use	Drug use and self-reported psychological distress higher amongst this sample than in a reference cohort	Probable selection bias, little adjustment for confounding, arguably a case-control study.
Choquet 1988, France ⁸⁴	High school students	Drug use associated with higher self-reported health problems and use of health services	No adjustment for confounding in analyses reported
Farrell 1993, USA ⁸⁵	High school students	Drug use associated with lower self-reported emotional restraint in a reciprocal manner	Probable selection bias, limited adjustment for confounding, significance of outcome measure unclear
Huizinga 1994, USA ⁸⁶	“High risk” youths	Positive association between drug use and self-reported antisocial behaviour	This association is alluded to in text though actual analyses are not presented. Impossible to critically appraise.

Sanford Canada ⁸⁷	1994,	Population based sample of adolescents	Heavy drug use associated with a greater risk of reporting work-force involvement (as opposed to continued schooling)	Potential selection bias due to large loss to follow-up.
Schulenberg USA ⁸⁸	1994,	High school students	Drug use and lower grade point average positively associated with later self-reported drug use	Focus of the “Monitoring the Future” surveys (from which these data derive) is on patterns and antecedents, rather than consequences, of drug use
Anthony 1995, USA ⁸⁹		Population based sample of adolescents reporting drug use	Earlier drug use associated with greater risk of developing later self-reported drug problems	Possible selection bias and limited adjustment for confounding. Focus of the epidemiologic catchment area programme (of which this was a sub-study) is on the descriptive epidemiology of mental illness in the community rather than the consequences of drug use.
Farrington 1995, UK ⁹⁰		“Working-class” male school children.	Positive association between drug use and measures of anti-social behaviour derived from self-report, school-reports and official records	Specific relation between drug exposure and subsequent behavioural outcomes not reported. Focus of the study is on antecedents of “delinquency”. Drug use is reported as part of the delinquency spectrum.
Krohn 1997, USA ⁹¹		“High risk” school children.	Drug use positively associated with earlier school leaving, earlier independent living and earlier parenthood – particularly amongst women	Possible selection bias. Limited adjustment for confounding.
Luthar 1997, USA ⁹²		High school students	Drug use associated with increased risk of self-reported depression, maladjustment and internalising of problems	Small study, short follow-up limited adjustment for confounding.

Stanton 1997, USA ⁹³	Black adolescents recruited from an HIV risk reduction project	Drug use weakly associated with self-reported risky sex, fighting and weapon carrying	Possible selection bias, limited adjustment for confounding.
Rao 2000, USA ⁹⁴	Female high school students	Substance use disorder positively associated with self-reported depression	Possible selection bias, small sample, limited adjustment for confounding
Studies reporting outcomes related to specific drug exposure			
Epstein 1984, Israel ⁹⁵	High school students	Alcohol and tobacco use associated with earlier sexual intercourse and earlier leaving education. Cannabis use also reported to be associated with the latter (analyses not shown)	Small study, no adjustment for confounding. Since latter analyses not reported impossible to critically appraise in this regard.
Kaplan 1986, USA ⁹⁶	High school students	Early cannabis use along with use associated with self-reported psychological distress associated with greater reported escalation of use and later psychological distress	Potential selection bias. Focus of the study is not on consequences of drug use.
Tubman 1990, USA ⁹⁷	Children of “middle class” families	Alcohol, tobacco and cannabis use all positively associated with self-reported symptoms of psychological distress.	Small study, possible selection bias, focus on antecedents rather than consequences of drug use
Scheier 1991, USA ⁹⁸	High school students in drug prevention programme	Cannabis use positively associated with risk of use of other illicit drugs and with socially negative attitudes	Probable selection bias, limited adjustment for confounding.

Hammer Norway ⁹⁹	1992,	“High risk” adolescents	Cannabis use positively associated with self-reported symptoms of psychological distress	Possible selection bias, limited adjustment for confounding
Degonda Switzerland ¹⁰⁰	1993,	Population based sample of young adults	Cannabis use positively associated with self-reported symptoms of agoraphobia and social phobia.	Possible selection bias, limited adjustment for confounding
Romero Spain ¹⁰¹	1995,	High school students	Cannabis use inconsistently associated with different dimensions of self-reported self-esteem	Loss to follow-up not reported, limited adjustment for confounding, relevance of outcome unclear.
Andrews USA ¹⁰²	1997,	Adolescents responding to an advertisement	Tobacco and cannabis use associated with lower academic motivation in a reciprocal manner.	Self-selected sample with high loss to follow-up. Limited control of confounding.
Patton Australia	1997,	High school students	Frequent cannabis use strongly positively associated with reported risk of self-harm in females. Weak, negative association in males.	Short follow-up, limited adjustment for confounding.
Hansell White USA ¹⁰³ ¹⁰⁴	1991 and 1998,	Telephone survey of adolescents	Cannabis and cocaine use associated with higher self-reported aggression and psychological distress	Possible selection bias, limited adjustment for confounding, relevance of outcome measures unclear
Costello USA ¹⁰⁵	1999,	“High risk” adolescents	Alcohol, tobacco, cannabis and other drug use positively associated with self-reported psychological distress and behavioural problems	Probable selection bias, limited adjustment for confounding.
Duncan USA ¹⁰⁶	1999,	“High-risk” adolescents	Alcohol, tobacco and cannabis use all positively associated with risky sexual	Small sample, possible selection bias, limited adjustment for confounding.

			behaviour. Association strongest for tobacco.	
Perkonig Germany ⁵²	1999,	Population based sample of adolescents	Cannabis use and dependence were generally sustained over the follow-up period	Focus of publications to date from this study has not been consequences of drug use
Huertas 1999, Spain ¹⁰⁷		High school students	Cannabis, alcohol and tobacco use positively associated with poorer school performance	No adjustment for confounding
Braun 2000, USA ¹⁰⁸		Population based sample of adolescents	Cannabis and tobacco use weakly associated with lower income and less prestigious employment. Association stronger with tobacco and amongst white participants	Possible selection bias, limited adjustment for relevant confounders (focus of the study is on development of cardiovascular risk).

Table 2. Description of participants setting and measures used in studies reviewed in detail

Study	Participants and setting¹	Drug exposure measures²	Other measures³
National Longitudinal Study on Adolescent Health ^{16 42}	National representative sample of 7-12 th grade students sampled from 80 high schools and their “feeder” schools in the US. Recruited in 1995. 79% of schools selected agreed to participate. 75% of eligible students in these schools (n=90118) completed a self-completion questionnaire. Random sub-sample of these selected for follow-up home interview in 1996, 79.5% of these (n=12118) contacted	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Cigarette smoking, alcohol use, gender, family structure, parent education, age, ethnicity
The Boston Schools Project ^{14 109}	1925 students from 3 public schools in Boston, US recruited aged 14-15 years in 1969 and studied annually till 1973 then again in 1981. 79% (n=1521) had complete follow up.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Socialisation, grade point average, self-reported physical and psychological health problems
The Children in the Community Project ^{18 45}	Population based sample of families in New York State, US. 976 participants aged 5-10 years at time of recruitment in 1975. 709 followed up till age 27 years.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Personality factors, family factors, parental drug use, sibling factors, peer factors, licit drug use All self-reported via standard instruments

The Central Harlem Study ¹⁹	Population based sample of black adolescents recruited in 1968-69 from Central Harlem, New York City. Initial sample of 668 age 12-17 years. 392 (59%) followed up till 1990.	Cumulative use index based on self report of lifetime use (more than once) of 9 classes of substance (marijuana, LSD, cocaine, heroin, methadone, “uppers”, “downers”, inhalants, alcohol)	Lifestyle and health behaviours, social ties and networks, adult social attainment
The Christchurch Health and Development Study ^{22 30 31 32 38}	Birth cohort of 1265 children born in Christchurch, New Zealand during mid 1977. Reassessed regularly till age 21. 80% had complete follow up.	Self-reported frequency of cannabis use via standard instrument. Categorical scale derived from this	Licit drug use, family background and parental factors, childhood behaviour, early problem behaviour, early psychological problems, educational history, cognitive ability, peer affiliations, antisocial behaviour, social environment, history of sexual abuse. Generally self-reported, some use of official records
Dunedin Multi-disciplinary Health and Development Study ^{23 33 74 75}	Birth cohort of all children born at, Dunedin, New Zealand between 01/04/1972 - 31/03/1973 who were still resident locally when the study began in 1975. 1649 children born during study recruitment period, 1139 of these still resident locally at age 3, 1037 of these successfully recruited to study (91%). Reassessed regularly till age 26. 96% of survivors had complete follow up.	Self-reported frequency of cannabis use via standard instrument. Categorical scale derived from this	Perinatal assessment, early physical health and development, childhood physical and psychological health, emotional and educational development, social and family environment, cognitive abilities, adolescent physical and psychological health, licit drug use, antisocial behaviour Generally self-reported, some use of official records

East Harlem Study ¹²	1332 African-American and Puerto Rican adolescents (mean age 14 at recruitment) from 11 schools in East Harlem, New York City in 1990. 66% followed up 5 years later.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Adolescent personality attributes, family relationship characteristics, peer factors, residential area, acculturation measures
The LA Schools Study ^{3 110 111}	1634 students in grades 7, 8 and 9 recruited from 11 schools in Los Angeles, US in 1976. Assessed regularly over the subsequent 21 years. 30% (477) had complete follow up.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Social conformity, family formation, deviant behaviour, sexual behaviour, educational pursuits, livelihood pursuits, mental health including depression, social integration and conformity, relationship quality, divorce, sensation seeking, parental support, academic aspiration, parental drug problems, psychological distress
New York Schools Study ^{15 26 49 112}	1636 adolescents enrolled in New York State public secondary schools in 1971. Aged 15 at recruitment. Re-interviewed in 1980, 1984 and 1990. 1160 (71%) had complete follow up.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Income, marital status, education level, ethnicity, peer activity, employment history, self-assessed health.
National Collaborative Perinatal Project (NCP) ²⁴	Sub-sample of NCPP cohort (African-American birth cohort followed till age 7 years) members in Philadelphia. Recontacted at age 24 and again at age 26. Approximately 70% (n=380) of target sub-sample had complete follow-up	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Perinatal and early life environmental factors, early health and development, academic performance, school behaviour and adjustment (from school records), personality, social integration, reported illness symptoms, reported antisocial behaviour and sexual behaviour

National Longitudinal Survey of Youth ^{20 50}	National representative sample of 12,686 young people (aged 14-21) from the noninstitutionalised civilian segment of the US population, recruited in 1979. Ongoing regular assessment with approximately 90% retention.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this (these questions were added in 1984)	Alcohol use, educational attainment, ethnicity, family background, parental factors, cognitive function, religion, , employment history, social position.
Pittsburgh Youth Study ¹⁷	School based sample of 850 boys from public schools in Pittsburgh. Mean age 13.25 years at recruitment followed up till mean age 18.5 years.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this. Parent/ teacher reports used to corroborate this in some instances	Anti-social behaviour and conduct disorders, psychological symptoms, relations with parents, neighbourhood factors, sexual behaviour, educational attainment.
Project Alert ¹³	4500 adolescents from 30 junior high and middle schools in California and Oregon participating in evaluation of a preventive intervention. Mean age of participants at baseline 13 years, followed up for 4 years.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this Salivary cotinine used to validate reported tobacco use (suggested to subjects that sample could also be tested for cannabis, it wasn't but this may have influenced validity of reported cannabis use).	Family and parental factors, social position and environment, employment history, educational history, anti-social behaviour, peer factors, religiosity.
South Eastern Public schools study ¹¹	Four longitudinal surveys within the US SE public schools. Participants recruited in grades 6-8 in 1985-87 and followed up till 1993-94. 1392 subjects (55.1%) had complete follow up.	Indicator variable derived from self reported age of initiation of use of cannabis and other illicit drugs.	Ethnicity, parental factors, educational attainment from combination of self-report and official records

Swedish Military Conscripts study ^{21 29 36 78}	Different subgroups of 50,465 Swedish men age 18-20 conscripted for national military service in 1969-1970. Follow up in official records to 1986, recently extended to 1996.	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this (90% of sample provided usable data).	Social position, licit drug use, parental and family factors, behavioural factors, psychological factors
Woodlawn study ¹⁰	1242 African-American 1 st grade students starting school in 1966-76 in a disadvantaged inner-city neighbourhood of Chicago. Follow up assessments in 1976-77 and 1992-94. (84% of original cohort located, 96% of those interviewed)	Self-reported frequency of cannabis and other drug use via standard instrument. Categorical scale derived from this	Licit drug use, family factors, parental factors, behavioural development, psychological problems, social integration, sexual behaviour, anti-social behaviour, educational history, employment history, religiosity.

1. In some instances data on completeness of follow up not reported
2. “Standard instrument” implies some details of validation given. Instruments were not standardised between studies.
3. Main groups of other measures as reported, for complete list see individual publications.

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