

Cannabis use and mental health in secondary school children

Findings from a Dutch survey

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Background Cannabis use is associated with mental health problems, and young people in particular are at risk.

Aims To investigate the association between cannabis use and mental health in adolescence.

Method Data from 5551 adolescents aged 12–16 years were drawn from the Dutch Health Behaviour in School-Aged Children school survey, carried out as part of the international 2001 World Health Organization project.

Results After adjusting for confounding factors, cannabis use was linked to externalising problems (delinquent and aggressive behaviour) but not to internalising problems (withdrawn behaviour, somatic complaints and depression). An increasing frequency of use resulted in stronger links. No significant gender or age by cannabis interaction effects were found.

Conclusions In a country with a liberal drug policy like The Netherlands, cannabis use is associated with aggression and delinquency, just as in other countries. Cannabis use was not associated with internalising problems. Alcohol use and regular smoking were strong confounding factors.

Declaration of interest None.

There is a growing concern about the adverse effects of cannabis use, especially with regard to young people (Fergusson *et al*, 2002). Population studies have found increased rates of externalising disorders, such as juvenile offending and conduct problems (Fergusson *et al*, 2002), and to a lesser extent internalising disorders such as psychosis (Arsenault *et al*, 2002) and depression (Degenhardt *et al*, 2003), among cannabis users. Studies have shown that adjustment for confounding factors weakens the associations between cannabis use and such disorders. The aims of our study were to ascertain the association between cannabis use and mental health disorders among Dutch adolescents and to investigate the role of confounding factors in a systematic way. The availability of cannabis and the illegality and criminality concerning this drug have been put forward as explanations for associations between cannabis use and mental health disorders (Fergusson *et al*, 2002). The results will therefore also be discussed in the light of the liberal drug policy in The Netherlands.

METHOD

Sample

This study was conducted as part of the World Health Organization cross-national study Health Behaviour in School-Aged Children (HBSC), addressing health behaviours, health and its social context in children and adolescents in Europe and North America (Currie *et al*, 2004). In accordance with the HBSC guidelines, a two-stage random sampling procedure was used (Currie *et al*, 2001). First, schools were stratified according to level of urbanisation. Second, schools were drawn proportionally to their number in the corresponding urbanisation level. Third, within each school, one class from every grade (1–4) was selected randomly from a list of all classes provided by every

participating school. Fourth, within classes all students were drawn as a single cluster. This procedure resulted in a sample of 5730 students from secondary schools. Of these respondents, 97% (5551) were in the 12–16 year age group, 0.3% were younger (10–11 years old) and 2.8% were older (17–18 years old). Because of the small number of respondents in the two latter age-groups, only those aged 12–16 years were included in the analyses. The response rate of schools was 45% (66 out of 146 schools). Non-response reasons had to do with lack of time (42%) or other research going on (32%). Schools that responded did not differ from schools that did not with regard to urbanisation level or school size. At the class level, only two classes were difficult to reach in the procedure (owing to timetabling problems in the school). In these cases, the school chose another class from the same grade and school type after consultation with the researchers. The non-response in classes was low: on average 5% of the students were not reached, mainly owing to illness. To make it possible to generalise the results to the general school-going population, a weighting procedure was applied. Post-stratification weights were calculated by comparing sample distributions and known population distributions of gender, school level and level of urbanisation (the national statistics were obtained from the Central Bureau for Statistics; see <http://www.cbs.nl>).

Data collection

All data were collected by means of questionnaires, which were distributed in classes and administered by the teachers (at four schools by a research assistant) during a lesson (usually 50 min). Teachers emphasised the anonymity of the respondents when introducing the questionnaire. Collecting all questionnaires in one envelope and sealing the envelope in the presence of the respondents further ensured anonymity.

Measures

Mental health

Mental health was measured using the Youth Self Report (YSR; Achenbach, 1991). This is designed to be completed by adolescents aged 11–18 years, and contains 101 problem items (0, not true; 1, somewhat true; 2, very true or often true, on the basis of the preceding 6 months). The YSR can be scored on the total

problem scores (sum of all scores) and the following eight sub-scales: withdrawn, somatic complaints and anxious/depressed (internalising problems), delinquent and aggressive behaviour (externalising problems), and social problems, thought problems and attention problems (the latter three are not part of either the internalising or externalising scale). The delinquency scale of the YSR contains one item on substance use; to avoid spurious associations, this item was omitted. The reliability and validity of the YSR are documented by Achenbach (1991). It has been translated and validated for Dutch use by Verhulst *et al* (1997).

Cannabis use

Cannabis use was measured by asking 'How many times did you use cannabis?' This question was asked for two time frames: 'in your whole life', identifying lifetime users, and 'in the last year', identifying past-year users. Students could answer by ticking off the number of times they had used cannabis (never, 1 or 2, 3–5, 6–9, 10–19, 20–39, 40 or more). According to the HBSC standard, the results on both answers were combined and recoded into five cannabis use subgroups:

- (a) those who had never used;
- (b) those who had used but not during the past year (discontinued use);
- (c) those who used once or twice during the past year (experimental use);
- (d) those who reported using cannabis between 3 and 39 times during the past year (regular use);
- (e) those who reported using it 40 times or more during the last year (heavy use).

Confounding factors

To adjust for confounding we included the following factors. Frequency of alcohol use was measured by the question 'How often do you take a drink containing alcohol, such as beer, wine, spirits or mixed drinks?' (never, now and again, every month, every week or every day). Answers were recoded into two categories, combining the first two answers in 'seldom or never' and the last three in 'at least every month'. Regular smoking was defined as current smokers, smoking at least once a week. Socio-demographic measures included age (in years), gender, household composition (not living with both biological parents,

living with both biological parents) and family affluence (low, medium or high). Family affluence was assessed using four questions concerning the presence of material goods in the family: number of cars, student having a bedroom of his or her own, number of computers, and number of times the family goes on holiday. Together these items can be interpreted as a proxy for prosperity of the family (Currie *et al*, 1997). In accordance with the HBSC protocol (Currie *et al*, 2001) the answers were recoded into the above-cited three categories. Social support from father, mother and friends (good, poor or no contact) was assessed using items of the core questionnaire of HBSC (Currie *et al*, 2001).

Data analysis

In order to obtain correct 95% confidence intervals and *P* values in a weighted and clustered sample, robust standard errors were obtained (Skinner *et al*, 1989). To investigate the association between cannabis use and mental health problems, multivariate linear regression analyses were conducted, resulting in standardised regression weights (β).

The association between cannabis use and mental health and the role of confounding factors was investigated in the following way. Cannabis use was included in the model as an independent variable, dichotomised into 'not used during the past year' (reference category) and 'used at least once during the past year'. Problem scores on each of the eight sub-scales were included as outcome variables. Together with confounding factors, these variables were included in a linear regression model. The selection of these confounders was based on the outcomes of other studies (e.g. McGee *et al*, 2000; Rey *et al*, 2002) and the results of earlier analyses (not shown) using the same data-set, showing a significant association between those factors and mental health problems. Additional analysis showed that these factors were also related to cannabis use and were therefore confounding factors in the association between cannabis use and mental health. The association between cannabis use and mental health was investigated using four models, each adding new confounding factors to the previous one. In the first model, the results were adjusted for age and gender only; the second in addition took family factors and social support into account (family affluence, household composition

and relationship with parents and friends); a third added alcohol use to the previous model; and a fourth added regular smoking as a confounder to the third model. To investigate gender and age effects, two-way interaction terms gender $\times$ cannabis use and age $\times$ cannabis use were added to the fourth model (thus including the full set of confounding factors).

To investigate the association between frequency of cannabis use and mental health, a five-category cannabis use variable was created (see Measures section): no use (reference group), discontinued use, experimental use, regular use and heavy use. This five-category variable was included in the model as an independent variable while correcting for age, gender, family factors and social support. All analyses were carried out with Stata version 7.0 for Windows.

RESULTS

The sample consisted of 5551 respondents, of whom 49% were female. Table 1 shows that past-year cannabis use rises steeply with increasing age and is already at a high level in the young age-groups; among the 14-year-olds 17% had used cannabis in the past year. Significantly more boys than girls had used cannabis (17% *v.* 13%; design-based $F_{(1,65)}=10.3$, $P<0.01$). More than four-fifths (82%) of the respondents had never used cannabis at the time of the interview, 3% had used it but not during the past year (discontinued use), 5% had used cannabis once or twice (experimental use), 7% had used it between 3 and 39 times during the past year (regular use) and 2% reported using 40 times or more during the past year (heavy use).

Association between past-year cannabis use and mental health problems, adjusting for confounding factors

Table 2 gives the adjusted standardised regression weights (β) for the association between past-year cannabis use and mental health problems. The results show that cannabis use among adolescents is related to several mental health problems, with especially strong associations for delinquent and aggressive behaviour. Model 1, only including age and gender as confounding factors, showed significant associations for all syndromes except for social problems and withdrawn behaviour. In the second

Table 1 Past-year prevalence of cannabis use

Age ¹ (years)	Boys			Girls			Total		
	<i>n</i>	%	95% CI	<i>n</i>	%	95% CI	<i>n</i>	%	95% CI
12	441	3.6	1.8–5.4	536	0.4	0–1.0	977	1.8	0.9–2.7
13	732	8.5	5.9–11.1	682	5.5	3.3–7.7	1414	7.0	5.0–9.0
14	755	18.4	13.7–23.1	700	15.8	11.4–20.3	1455	17.2	13.7–20.6
15	610	25.1	21.2–28.9	593	20.1	16.0–24.1	1203	22.7	19.7–25.6
16	274	33.6	26.6–40.1	228	27.7	21.0–34.3	502	31.0	25.6–36.3
Total	2812	17.2	14.8–19.5	2739	12.9	10.7–15.1	5551	15.1	13.2–17.0

1. Results for those aged 10, 11, 17 and 18 years are not included because the number of respondents of these ages was small (see Method).

Table 2 Association between past-year cannabis use (reference: no cannabis use in past year) and Youth Self Report problem scores, reported for four models, each adjusting for a different set of confounding factors

Model ¹	Standardised β^2									
	Total score	Withdrawn behaviour	Somatic complaints	Anxious/depressed	Internalising behaviour	Delinquent behaviour	Aggressive behaviour	Externalising behaviour	Social problems	Thought problems
1	0.22		0.09	0.06	0.07	0.37	0.27	0.33		0.16
2	0.18		0.08		0.04	0.34	0.24	0.29		0.12
3	0.15		0.06			0.29	0.20	0.25		0.11
4	0.10					0.20	0.15	0.18		0.07

1. Model 1, adjusted for age and gender; 2, adds to model 1 controls for family affluence, household composition and social support; 3, adds to model 2 controls for alcohol use; 4, adds to model 3 controls regular smoking.

2. Only the results of significant effects are reported. All effects significant at level $P < 0.01$.

model, also adjusting for family factors and social support, all associations became somewhat weaker or lost significance (anxious/depressed). Adding alcohol use (model 3), and especially regular smoking (model 4), resulted in a further reduction of the associations. Factors remaining significant in the full model (model 4) were delinquent and aggressive behaviour (adjusted β s of 0.20 and 0.15 respectively), and thought and attention problems (adjusted β s of 0.07 and 0.06 respectively).

Interaction of gender and age

No significant interaction effects of gender $\times$ cannabis use were found (results on interactions are not shown in the table). All age $\times$ cannabis effects were in the same direction, i.e. among the younger cannabis user group relatively more students experienced problems than among the older cannabis user group; however, the interactions did not reach significance.

Association between cannabis use and mental health problems in different user groups

Table 3 shows the adjusted standardised regression weights (β) for the association between frequency of cannabis use (four cannabis user groups, with 'no use' serving as reference category) and mental health problems. The results are adjusted for all confounding factors (full model). The results show that associations are only present among those who used cannabis recently (during the past year) and tend to get stronger with increasing frequency of past-year use. In the 'discontinued use' group no significant association was found. In the group who used once or twice during the past year (experimental use) significant associations were found for delinquent and aggressive behaviour (adjusted β s of 0.07 and 0.08 respectively). Among the regular users, the strength of the associations was higher, particularly for delinquent behaviour ($\beta=0.17$). The strength of the associations in the heavy use group hardly

increased compared with the regular use group but the association with thought problems reached significance (adjusted $\beta=0.10$).

DISCUSSION

Limitations of the study

Potential limitations of this study include the reliance on self-report data. Responses to sensitive questions about undesirable or illegal behaviour may be biased. However, the administration of the questionnaires in school classes and assuring anonymity, as was done in this study, may help to generate reliable and valid data (Smit *et al*, 2002). A limitation of conducting a school survey is that truants and those who are often ill are likely to be partially missed. Since truancy is positively associated with substance use and mental health problems, this bias has probably resulted in an underestimation of the strength of the association as found in this study. However, the

Table 3 Association between cannabis use and Youth Self Report problem scores, reported for four different user groups and adjusted for confounding factors

User group ¹	Standardised β^2										
	Total score	Withdrawn behaviour	Somatic complaints	Anxious/depressed	Internalising behaviour	Delinquent behaviour	Aggressive behaviour	Externalising behaviour	Social problems	Thought problems	Attention problems
Discontinued											
Experimental	0.05					0.07	0.08	0.08			
Regular	0.07					0.17	0.11	0.14			0.04
Heavy	0.09					0.19	0.11	0.14		0.10	0.06

1. No use of cannabis (reference group); discontinued, used, but not during the past year; experimental, used once or twice during the past year; regular, used 3–39 times during the past year; heavy, used 40 or more times during the past year). Adjusted for age, gender, family affluence, household composition and social support, alcohol use and regular smoking.
 2. Only the results of significant effects are reported. All effects significant at level $P < 0.01$.

resulting bias is expected to be low, because the number of students not present in the classes owing to truancy was also small (0.5%). The response rate of schools was rather low (45%) in this study. However, it is unlikely that this influenced the results in any meaningful way. Response and non-response schools did not differ with regard to urbanisation level and school size. Furthermore, the prevalence rates for substance use found in this study fitted well with those found in the 1999 and 2003 waves of the Dutch National School Survey, a study with a higher response rate (70%; Monshouwer *et al*, 2004). Finally, this study has a cross-sectional design; therefore inferences on causal relations cannot be made.

Key results

With these limitations in mind, this study shows that at young ages the use of cannabis is already strongly associated with delinquent and aggressive behaviour, even after controlling for strong confounders such as alcohol use and smoking. The strength of the associations increased with higher frequency of use, and significant associations were only present among those who had used cannabis recently (lifetime cannabis users who had not used the drug during the preceding year were not at higher risk compared with those who never used cannabis). Among heavy cannabis users an association with thought problems was found. Associations between cannabis use and internalising problems were weak when controlling for age and gender and non-significant when other possible confounding factors were taken into account. Furthermore, when adjusting for confounding factors, no significant gender or age $\times$ cannabis use interaction was found.

Association between cannabis use and externalising problems

In line with the results of Rey *et al* (2002) and Fergusson *et al* (2002), we found strong associations between delinquent and aggressive behaviour and cannabis use, which became stronger with increasing frequency of use. Fergusson *et al* (2002) suggested that one possible mechanism is that the use of cannabis brings people into contact with the illegal drugs market and drug dealers, and this in turn might encourage involvement in other forms of crime. However, it is not expected that this mechanism has an important role in The Netherlands, because the use of cannabis is not illegal and people selling small amounts of cannabis in 'coffee shops' are not prosecuted if certain criteria are met. However, our study still finds a linkage between the use of cannabis and externalising problems. It is possible that this association is weaker than in other countries, but owing to differences in outcome measures between studies it is difficult to investigate this issue. An alternative explanation is that cannabis use in The Netherlands, as elsewhere, is part of a deviant behaviour pattern, also involving other 'problem behaviours' such as truancy, other substance use and delinquency (Jessor, 1987). This co-occurrence is possibly (partly) related to the fact that these different problem behaviours are linked to a similar set of risk factors (McGee *et al*, 2000). McGee *et al* (2000) found a strong cross-sectional association between cannabis use and externalising behaviours at age 15 years, but not at ages 18 and 21. They explained this by the fact that cannabis use at ages 18 and 21 is more normative than at age 15. Cannabis use in adolescence might thus also (in part) reflect a drive among adolescents towards rebellious behaviour

(Brook *et al*, 2001). It might be assumed that since the use of cannabis is not illegal and people are not prosecuted for selling cannabis in 'coffee shops', the use of cannabis is also generally accepted behaviour in The Netherlands. However, this does not seem to apply to its use by adolescents. Most parents and teachers strongly disapprove of the use of cannabis by adolescents; in a 1999 survey by the Trimbos Institute, 95% of secondary school students reported that their parents forbade or disapproved of the use of cannabis (further information available from the author upon request). This makes cannabis use in adolescence part of a deviant behaviour pattern in The Netherlands as in other countries. It is notable that regular tobacco smoking, which may be considered less non-normative behaviour than cannabis use, explained a substantial part of the association between cannabis and delinquent and aggressive behaviour. This may possibly be due to common risk factors. It may also be that regular smoking is accepted behaviour for adults but not for adolescents. Therefore, regular smoking might also be a way for adolescents to show rebelliousness.

Association between cannabis use and internalising problems

Several studies report associations between cannabis use and depressive disorders (Fergusson *et al*, 2002; Patton *et al*, 2002; Rey *et al*, 2002), but others do not (McGee *et al*, 2000; Degenhardt *et al*, 2001; Arseneault *et al*, 2002). In our study the association was weak when controlling for age and gender and non-significant when other possible confounding factors were taken into account. Degenhardt *et al* (2001), in an Australian adult population, also found the association between cannabis use and affective disorders disappeared

after including alcohol and tobacco use in the analysis. This is in line with the results of the study by Boys *et al* (2003), which found a significant association between cannabis use and depressive disorders only among those who were also regular smokers and/or drinkers. McGee *et al* (2000) found that tobacco use at age 15 years did predict later mental health problems, whereas this effect was not found for cannabis use. Fergusson & Horwood (1997) found dose-response relationships between the extent of early cannabis use (at ages 15 and 16 years) and major depression at ages 16–18 years, but this association lost statistical significance after adjusting for several antecedent factors. In a review study of the association between cannabis use and depression, Degenhardt *et al* (2003) found that few studies have controlled for potential confounding variables; studies that did so found that the risk is much reduced by a statistical control, but a modest relationship remains. Degenhardt *et al* (2003) concluded that heavy cannabis use might increase depressive symptoms in some users, but also stated that it is too early to rule out the hypothesis that the association is due to common risk factors.

To conclude, in line with other research this study shows that the association between cannabis use and internalising problems is weak, and non-significant after adjustment for confounding factors. However, these results do not rule out the possibility that there is a small group of people with a pre-existing vulnerability for whom cannabis use does involve an increased risk of internalising problems (Henquet *et al*, 2005).

Association between cannabis use and attention problems

After adjustment for confounders, the association between cannabis use and attention problems was significant. It is therefore not unlikely that cannabis use is associated with poor school performance. Additional analyses showed that those using cannabis reported lower-than-average school performance significantly more often than those who did not use cannabis (13% and 4% respectively). Lynskey & Hall (2000) concluded in their review that early cannabis use might significantly increase risks of subsequent poor school performance and, in particular, early school leaving. However, they stated that there was little support

CLINICAL IMPLICATIONS

- Cannabis use is associated with aggression and delinquency, even in a country with a liberal drug policy like The Netherlands.
- No association between cannabis use and internalising problems was found; however, this does not rule out the possibility that a small group of vulnerable people is particularly at risk.
- The strong confounding effects of alcohol use and smoking show that cannabis use is not a unique factor, but is one of several substances related to mental health problems.

LIMITATIONS

- The data are based on self-report; responses to sensitive questions about undesirable or illegal behaviour may be biased.
- Truants and those who are often ill were likely to have been partially missed.
- The study has a cross-sectional design, which means inferences on causal relations cannot be made.

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for a causal relationship between cannabis use and poor school performance, and proposed that the link is probably explained by common risk factors. In a longitudinal study, Fergusson *et al* (2003) came to a similar conclusion.

Association between cannabis use and thought problems

In this study we found a moderate association between cannabis use and thought problems. These findings might point to an increased vulnerability for psychotic symptoms in young people using cannabis. However, using the same data-set, regular smoking and alcohol use were also associated with thought problems. This could imply that certain characteristics of the substance-using adolescent explain the association with thought problems rather

than a direct effect of cannabis use. However, on the basis of our study we cannot draw conclusions on this topic.

Gender differences

Several studies have reported girls using cannabis to be at higher risk of mental health problems than comparable boys. For example, Patton *et al* (2002), investigating the relationship between cannabis use and depression and anxiety, found a significant interaction effect between gender and frequent use. Pedersen *et al* (2001) found the effect of conduct problems on cannabis initiation measured 18 months later to be stronger in girls than in boys, and explain this finding by the 'gender paradox': in disorders with unequal gender ratio (such as conduct problems), the group with the lower prevalence rate often seems more seriously affected. In this

study no interaction effect for gender was found. We have no explanation for this difference in results.

Age differences

In this study no significant age-related effect of cannabis use was found, in contrast to other studies (Ehrenreich *et al*, 1999; Fergusson *et al*, 2002). This might be because our study measured whether cannabis use was present at the age at the time of the interview, whereas it would probably have been better to have used a measure of the age at first cannabis use; but this was not included in the data-set. However, although not significant, all associations were in the expected direction: i.e. the risk of mental health problems increased with decreasing age of cannabis use.

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