

## Less adolescent alcohol and cannabis use: More deviant user groups?

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### Abstract

**Introduction and Aims.** Adolescent drinking and cannabis use in Norway declined in the 2000s, and we tested the assumption that psychosocial problems were more strongly related to substance use when the prevalence was quite low (2012/2013) than when it was considerably higher (2002). **Design and Methods.** Data stemmed from school surveys of almost 20 000 students aged 14–17 years in 2002 and 2012/2013 in the four largest cities in Norway. We assessed how various deviant behaviours and depressive mood were related to past-year measures on any alcohol intoxication, frequent intoxication (6+ times) and any cannabis use, and tested whether the associations varied significantly by survey year. **Results.** The prevalence of any intoxication episodes dropped markedly from 2002 (50%) to 2012/2013 (28%), as did the prevalence of frequent intoxication (29% vs. 10%) and any cannabis use (15% vs. 7%). Deviant behaviours and depressive mood were either more closely related to the drinking outcomes in 2012/2013 than in 2002, or the associations showed no temporal change. None of the associations with cannabis use varied significantly by survey year. **Discussion and Conclusion.** The assumption that psychosocial problems correlated more strongly with alcohol and cannabis use in a low-prevalence period (2012/2013) as compared to a high-prevalence period (2002) was partly supported, but only with respect to drinking. The strength of the associations with cannabis use was stable, which may reflect that the proportion reporting any use of the drug was low even in the relatively 'high-prevalence' period. [Pape H, Rossow I. Less adolescent alcohol and cannabis use: More deviant user groups? *Drug Alcohol Rev* 2021;40:118–125]

**Key words:** alcohol, cannabis, adolescents, social deviance, temporal change.

### Introduction

The prevalence of adolescent drinking dropped in numerous high-income countries after the millennium shift [1,2], and quite a few countries also witnessed a decline in cannabis use by youth [3–5]. According to the European School Survey Project on Alcohol and Other Drugs study of 15–16-year olds in Europe, Norway was one of the countries where adolescents' use of both substances has decreased in the 2000s [5,6]. The present study is based on another dataset of Norwegian youth, which allowed us to examine whether the reduction in alcohol and cannabis use was accompanied by changes in the correlates of using these substances.

In several countries, males reduced their drinking to a greater extent than females and hence, the association between gender and alcohol use attenuated [2]. Moreover, the decline has generally been larger in younger than in older teenagers, implying that the age gradient in

youth drinking has become steeper. But what, if anything, happened to the associations between psychosocial problems and substance use by youth?

Numerous studies show that adolescent substance use is linked to involvement in other problem behaviours [7–11], which in part may reflect differential selection processes. Indeed, longitudinal research provides evidence that individuals with a pre-existing tendency to violate behavioural norms are more likely to start drinking early, to drink heavily and to experiment with illicit drugs [12–17]. Some scholars have theorised that the clustering of substance use and other problem behaviours is a manifestation of a general deviance syndrome, reflecting shared underlying influences such as dispositional impulsivity [18] or weak self-control [19]. Associations between mental health problems and adolescent substance use have also been reported, and some studies have found that depressiveness is prospectively related to both alcohol and cannabis use [20–23].

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How strongly mental health problems and involvement in deviant behaviour are associated with substance use may depend on whether the prevalence of the substance use behaviour in question is high or low. For instance, the popularity of a specific drug in the general youth population seems to be inversely related to the extent of deviance characteristics among its users—in terms of both mental health problems and delinquency [10]. Correspondingly, the link between psychosocial problems and adolescent cannabis use tends to be stronger in low-prevalence countries than in high-prevalence countries [24–27]. Other studies have found that violence and other deviant behaviours were significantly less closely related to heavy episodic drinking when the youth culture was relatively ‘wet’ as compared to a period when it was quite ‘dry’ [28,29].

The above-mentioned results fit the short-lived normalisation thesis [30,31], which was advanced in the context of the upward trends in adolescents’ use of cannabis and some other drugs in the 1990s. It posited that substance use became too prevalent to be considered deviant in this period, attracting ordinary, well-adjusted youth who needed a timeout from the demanding journey into adulthood in postmodern societies. No theories on de-normalisation of adolescent substance use have been developed in relation to the post-millennium downward trends, and why the tide turned is far from clear [32].

There is, however, cross-national evidence of more restrictive alcohol-related parenting in the 2000s, as well as increased disapproval of underage drinking among adolescents themselves [2,32,33]. When such changes in the normative climate occur, one may assume that the selection into the user groups becomes more biased with respect to psychosocial problems. Indeed, a Finnish study found that depressed adolescents in socioeconomically disadvantaged groups did not follow the downward drinking trend, but *increased* their alcohol consumption in the 2000s [34].

On the other hand, according to Pape and co-workers’ [2] literature review of the post-millennium declines in drinking, ‘underage drinkers have apparently not become a more deviant group as the prevalence of drinking has dropped, indicating no hardening of the group’. However, none of the few studies that addressed the issue involved drinking behaviour that had changed from being relatively widespread to becoming quite rare. Moreover, no study—to our knowledge—has examined whether the recent decline in adolescent cannabis use in quite a few countries [3–5] has been accompanied by a shift towards more deviant or vulnerable user groups. It is also unknown whether the few countries in which adolescent cannabis use increased in the 2000s (e.g. Poland [5]), also witnessed that the drug increasingly attracted well-adjusted groups.

## Aims

Focusing on mental health problems and engagement in deviant behaviour, we tested the assumption that such psychosocial problems were more closely related to alcohol and cannabis use when the prevalence of using these substances was low (2012/2013) as compared to a period when the prevalence was relatively high (2002).

## Methods

We analysed cross-sectional data from two school-based surveys. The first, *Young in Norway 2002*, included a balanced selection of junior and senior high schools from all national regions [35]. From this dataset, we extracted a subsample of 9th, 10th and 11th graders (14–17-year olds) in the four largest cities in Norway (Oslo, Bergen, Trondheim, Stavanger). Full cohorts of 9th–11th graders in the same cities were assessed in 2012/2013 as part of a quality assured and standardised system of school surveys in Norwegian municipalities. These surveys all build on a common template, which to a large extent resembles the 2002 survey.

Data were collected by means of anonymous questionnaires that were distributed and filled out in the classroom. The surveys were conducted in accordance with the Guidelines for Research Ethics in the Social Sciences [36]. Details about the study design, the data collection procedures and the ethical approval are provided elsewhere [35,37].

The overall response rate was 92% in 2002, while it ranged from 65% (Bergen) to 83% (Trondheim) in 2012/2013. Some students (1.3% in 2002 and 2.0% in 2012/2013) had missing data on both alcohol and cannabis use, and were omitted from all analyses. The net sample included 1009 respondents in 2002 and 18 941 in 2012/2013. The large difference in sample sizes reflects that the 2002 survey included a selection of schools in each city, while the 2012/2013 surveys included all eligible schools.

## Measures

*Alcohol and cannabis use.* The frequency of ‘feeling clearly intoxicated’ by alcohol and the frequency of cannabis use in the past 12 months were assessed on this response scale: no times; once; 2–5 times; 6–10 times; and 11 or more times. Dichotomous measures on any intoxication, frequent (6+ times) intoxication and any cannabis use were used in the main analyses. In some sensitivity analyses, we applied semi-

continuous variables (e.g. 6–10 times = 8) where the highest frequency category (11+ times) was coded 15. Alcohol intoxication and cannabis use were outcome measures, yet they were also considered to be behavioural problems and analysed as independent variables. That is, cannabis use was included as an independent variable in the analyses of alcohol intoxication, and vice versa.

Involvement in deviant behaviour was assessed using a battery of nine items. The respondents were asked: 'How many times have you done any of the following things in the past 12 months', and the six response options ranged from no times (coded 0) to 11+ times (coded 15). We included the nine semi-continuous variables in an exploratory factor analysis, and three easily interpretable factors emerged: *Non-aggressive norm-violations* ('skipped school', 'spent the whole night away from home without your parents knowing where you were' and 'not paying for the cinema, sporting events, bus or train tickets etc., when you should have'), *school misconduct* ('severe quarrelling with a teacher' and 'been sent out of the classroom') and *criminality* ('burglary', 'been in a fight with a weapon (e.g. knife)', 'deliberately damaged or broken window panes, bus seats, post boxes etc.' and 'been in contact with the police due to illegal activities'). Next, we constructed three frequency measures by adding up the semi-continuous variables that belonged to each of the three behavioural domains. Due to skew distributions, the measures were dichotomised; frequent engagement (10+ times) in non-aggressive norm-violations, recurrent (2+ times) school misconduct and any criminal behaviour. The cut-off points were placed close to the 25th percentile in frequency distribution in the 2002 sample.

*Mental health problems* were assessed using six items from the Depressive Mood Inventory [38]. The respondents were asked to what extent they had been bothered by the following symptoms: 'felt that everything was a struggle', 'had sleep problems', 'felt unhappy, sad or depressed', 'felt hopelessness about the future' and 'worried too much about things' in the past week. The response scale ranged from 1 (not at all) to 4 (severely bothered). Cronbach's alpha was 0.83 in 2002 and 0.87 in 2012/2013. We added up and averaged the scores on the six items, and made a distinction between a low (scores  $\leq 2.5$ ) and a high (scores  $> 2.5$ ) level of depressive mood.

### Statistical analyses

The exploratory factor analysis of deviant behaviours employed principal components extraction (Eigenvalues  $> 1$ ) with direct oblimin rotation.

Variations in proportions between 2002 and 2012/2013 were assessed using cross-tabulations with  $\chi^2$ -test, while analyses of variance with  $F$ -test were used to assess differences between means. Moreover, we applied Poisson regression to estimate relative risks (RR). Specifically, we regressed each of the three dichotomous substance use variables on gender, school grade, involvement in deviant behaviours and depressive mood. Next, we compared the RRs in 2002 and 2012/2013 by estimating the ratio of relative risks with 95% confidence intervals [39]. We used SPSS version 26 and Stata version 16.0 for statistical analyses.

### Results

As displayed in Table 1, the gender distribution as well as the distribution of students across the three school grades were fairly even at both assessments, and there was no statistically significant cross-time variation in this respect. Table 1 also shows that the proportion reporting any intoxication episodes dropped markedly from 2002 (50%) to 2012/2013 (28%), as did the proportion reporting frequent intoxication (29% vs. 10%) and any cannabis use (15% vs. 7%). The relative magnitude of these reductions ranged from -45% (any intoxication) to -67% (frequent intoxication). The prevalence of frequent non-aggressive norm-violations, recurrent school misconduct and any criminal offending all declined by approximately 50%. The proportion with a high level of depressive mood moved in the opposite direction, and increased by 30%.

The decrease in intoxication and cannabis use from 2002 to 2012/2013 was highly evident for both genders, and for students in all three school grades (Table 2).

Next, we regressed a binary variable on survey year on each of the three substance use variables to assess whether the RR of substance use changed significantly from 2002 (reference category) to 2012/2013. The smaller the RR, the larger was the relative decline in substance use, and we tested whether the RRs varied by gender and school grade. Only one statistically significant gender difference was found: for any intoxication, the RR of survey year was smaller among males (RR 0.49, 95% confidence interval [CI] 0.45, 0.54) than among females (RR 0.60, 95% CI 0.55, 0.66). Moreover, the RRs of survey year were consistently smaller among the 9th graders than among older students. Specifically, the RR for any intoxication was 0.27 (95% CI 0.23, 0.41) among the 9th graders, 0.58 (95% CI 0.51, 0.65) among the 10th graders and 0.68 (95% CI 0.63, 0.74) among the 11th graders. The corresponding RRs for frequent intoxication were 0.12

**Table 1.** The distribution of gender and class grade and the prevalence of substance use, involvement in deviant behaviours and depressive mood in 2002 and 2012/2013. Percentages and percentage change

	Survey year		% change
	2002	2012/2013	
<i>Gender</i> <sup>ns</sup>			
Females	48.6	50.8	+4.5
<i>Class grade</i> <sup>ns</sup>			
9th grade	31.4	31.0	-1.3
10th grade	36.9	36.7	-0.5
11th grade	31.7	32.3	+1.9
Any alcohol intoxication*	50.3	27.6	-45.1
Frequent alcohol intoxication*	28.8	9.5	-67.0
Any cannabis use*	14.6	6.7	-54.1
Frequent non-aggressive norm-violations*	26.3	13.3	-49.4
Recurrent school misconduct*	24.3	11.2	-53.9
Any criminality*	28.0	13.0	-53.6
Depressive mood*	17.6	25.2	+30.2
<i>Lowest n</i>	986	18 430	

\* $P < 0.001$ .  $P$ -values for tests of differences between 2002 and 2012/2013. ns, not statistically significant.

**Table 2.** Prevalence of any and frequent alcohol intoxication and any cannabis use in 2002 and 2012/2013 by gender and school grade. Percentages and percentage change (reductions by more than 50% appear in bold)

	Any alcohol intoxication			Frequent alcohol intoxication			Any cannabis use			Lowest $n$	
	2002	2012/2013	% change	2002	2012/2013	% change	2002	2012/2013	% change	2002	2012/2013
Males	51.5	25.3	<b>-50.9</b>	30.3	9.0	<b>-70.3</b>	17.5	8.4	<b>-52.0</b>	510	9007
Females	49.4	29.8	-39.7	27.3	9.9	<b>-63.7</b>	11.5	5.0	<b>-56.5</b>	479	9276
9th gr	39.7	10.7	<b>-73.0</b>	19.2	2.2	<b>-88.5</b>	11.1	2.7	<b>-75.7</b>	314	5859
10th gr	44.9	26.0	-42.1	22.6	7.3	<b>-67.7</b>	10.8	6.0	-44.4	369	6919
11th gr	67.3	45.6	-31.2	45.6	18.9	<b>-58.6</b>	22.3	11.3	-49.3	318	6093

The differences between 2002 and 2012/2013 are statistically significant for both genders and for all three school grades ( $P < 0.001$ ).

(95% CI 0.09, 0.15), 0.32 (95% CI 0.26, 0.40) and 0.41 (95% CI 0.36, 0.47), respectively, while the RRs for any cannabis were use were 0.24 (95% CI 0.17, 0.34), 0.55 (95% CI 0.40, 0.75) and 0.51 (95% CI 0.41, 0.63). Hence, we adjusted for school grade in all subsequent analyses, and also for gender in the analyses of any intoxication episodes.

Table 3 shows that all measures on psychosocial problems were positively related to the three substance use outcomes in both 2002 and 2012/2013. Moreover, the associations were either significantly stronger at the most recent assessment, or they showed no statistically significant variation across time.

Cannabis use, frequent involvement in non-aggressive norm-violations, criminality and depressive mood were all significantly more strongly related to any intoxication episodes in 2012/13 than in 2002. For

instance, compared to other adolescents, those who had been involved in criminality were 2.0 times more likely to report any intoxication episodes in 2002, and 2.5 times more likely to do so in 2012/2013. Two measures (cannabis use and non-aggressive norm-violations) were also more closely related to frequent intoxication in 2012/2013 than in 2002. None of the associations between psychosocial problems and cannabis use showed statistically significant cross-time variation.

#### Sensitivity analyses

The mean frequency of alcohol intoxication among adolescents who reported any intoxication episodes

**Table 3.** Adjusted relative risks (RR) showing how deviant behaviours and depressive mood were associated with any alcohol intoxication, frequent alcohol intoxication and any cannabis use, and ratios of relative risk (RRR) showing whether the RRs in 2002 and 2012/2013 differed significantly (lowest n = 991 in 2002 and 17,796 in 2012/2013)

	Year	Any alcohol intoxication <sup>a</sup>			Frequent alcohol intoxication <sup>b</sup>			Any cannabis use <sup>b</sup>		
		RR (95% CI)	RRR (95% CI)	RR (95% CI)	RR (95% CI)	RRR (95% CI)	RR (95% CI)	RRR (95% CI)		
Frequent alcohol intoxication	2002	—	—	—	—	—	6.80 (4.76, 9.71)	0.84 (0.58, 1.22)	—	—
	2012/2013	—	—	—	—	—	8.08 (7.20, 9.06)	—	—	—
Any cannabis use	2002	2.06 (1.88, 2.26)	0.69** (0.62, 0.76)	3.19 (2.69, 3.78)	0.56* (0.37–0.86)	—	—	—	—	—
	2012/2013	3.00 (2.88, 3.13)	0.74* (0.58, 0.93)	5.69 (5.23, 6.20)	0.80* (0.66–0.99)	—	—	—	—	—
Non-aggressive norm-violations	2002	1.81 (1.63, 2.02)	0.95 (0.84, 1.18)	3.05 (2.54, 3.67)	0.95 (0.77–1.16)	—	—	—	—	—
	2012/2013	2.46 (2.36, 2.58)	0.80** (0.71, 0.90)	3.79 (3.48, 4.12)	0.86 (0.68–1.06)	—	—	—	—	—
School misconduct	2002	1.84 (1.65, 2.05)	0.81* (0.68, 0.91)	2.40 (2.00, 2.87)	0.90 (0.71–1.15)	—	—	—	—	—
	2012/2013	1.93 (1.83, 2.05)	—	2.53 (2.29, 2.80)	—	—	—	—	—	—
Criminality	2002	2.00 (1.79, 2.23)	—	3.00 (2.51, 3.59)	—	—	—	—	—	—
	2012/2013	2.51 (2.39, 2.63)	—	3.50 (3.21, 3.82)	—	—	—	—	—	—
Depressive mood	2002	1.18 (1.02, 1.37)	—	1.31 (1.05, 1.63)	—	—	—	—	—	—
	2012/2013	1.45 (1.38, 1.52)	—	1.45 (1.32, 1.59)	—	—	—	—	—	—

\* $P < 0.01$ ; \*\* $P < 0.001$ . <sup>a</sup>Adjusted for school grade and gender; <sup>b</sup>Adjusted for school grade only. CI, confidence interval.

was higher in 2002 ( $\bar{X} = 8.2$ ,  $SD = 5.56$ ) than in 2012/2013 ( $\bar{X} = 5.7$ ,  $SD = 4.87$ ) ( $P < 0.001$ ). Moreover, among those who had been drunk 6+ times (the ‘frequent intoxication’ group), the proportion reporting 11+ intoxication episodes was larger in 2002 (62.8%) than in 2012/2013 (51.6%) ( $P < 0.001$ ). Hence, the two groups of alcohol users differed at the two time points, not merely in terms of prevalence, but also with respect to the frequency of intoxication.

Against this backdrop, we constructed a dichotomous measure on infrequent intoxication (0 vs. 1–5 times), which was reported by 21.5% in 2002 and 18.1% in 2012/2013 ( $P < 0.01$ ). Among adolescents with such drinking behaviour, the proportion reporting recurrent (2+ times) drunkenness barely varied by survey year (i.e. 62.2% in 2002 and 61.1% in 2012/2013,  $P = 0.87$ ). As shown in Table 4, non-aggressive norm-violations and depressive mood were significantly more strongly related to infrequent intoxication in 2012/2013 than in 2002. None of the other associations varied significantly by survey year.

We also found that the mean frequency of cannabis use among those who reported any use of the drug was higher in 2002 ( $\bar{X} = 6.82$ ,  $SD = 5.75$ ) than in 2012/2013 ( $\bar{X} = 5.30$ ,  $SD = 5.28$ ) ( $P < 0.001$ ). The results of additional analyses paralleled those observed with respect to any intoxication episodes. That is, among adolescents who had used cannabis 1–5 times (8.5% in 2002 and 4.7% in 2012/2013,  $P < 0.001$ ), the proportion reporting recurrent use of the drug was not significantly different at the two assessments (54.1% in 2002, and 45.8% in 2012/2013,  $P = 0.14$ ). Moreover, the pattern of findings in Table 3 was replicated when we replaced the measure on any cannabis use with infrequent use of the drug (0 vs. 1–5 times). That is, none of the associations in question varied significantly by survey year.

## Discussion

The present study of urban youth in Norway showed that the prevalence of both alcohol and cannabis use dropped markedly from 2002 to 2012/2013, which agrees with the national ESPAD studies of Norwegian adolescents in approximately the same period [5,6]. The post-millennium decline in adolescent drinking has been particularly large in younger age groups in many countries [2], and we found that this applied to the downward trend in both alcohol and cannabis use.

Non-aggressive norm-violations, school misconduct, criminality and depressive mood were all positively related to alcohol and cannabis use in both 2002 and

**Table 4.** Adjusted<sup>a</sup> relative risks (RR) showing how deviant behaviours and depressive mood were associated with infrequent alcohol intoxication<sup>b</sup> in 2002 and 2012/2013, and ratios of relative risk (RRR) showing whether the RRs in 2002 and 2012/2013 differed significantly. (Lowest n = 712 in 2002 and 16 647 in 2012/2013)<sup>c</sup>

	Year	RR (95% CI)	RRR (95% CI)
Any cannabis use	2002	2.68 (2.17, 3.31)	0.81 (0.65, 1.01)
	2012/2013	3.31 (3.10, 3.53)	
Non-aggressive norm-violations	2002	1.57 (1.23, 2.00)	0.64** (0.50, 0.82)
	2012/2013	2.45 (2.30, 2.61)	
School misconduct	2002	2.07 (1.66, 2.58)	1.14 (0.91, 1.44)
	2012/2013	1.81 (1.68, 1.96)	
Criminality	2002	1.89 (1.50, 2.36)	0.79 (0.63, 1.01)
	2012/2013	2.38 (2.23, 2.54)	
Depressive mood	2002	1.13 (0.85, 1.50)	0.72* (0.54, 0.96)
	2012/2013	1.58 (1.49, 1.68)	

\*  $P < 0.01$ ; \*\*  $P < 0.001$ . <sup>a</sup>Adjusted for school grade; <sup>b</sup>1–5 times; <sup>c</sup>Adolescents reporting 6+ intoxication episodes were excluded. CI, confidence interval.

2012/2013. *A priori*, we assumed that the decline in substance use was accompanied by a strengthening of these associations, reflecting a change in the recruitment base towards relatively more deviant or vulnerable groups. This assumption was only partly supported. Specifically, the results indicated that the initial prevalence of substance use and the absolute magnitude of the decline made a difference.

Fifty percent reported at least one past-year intoxication episode in 2002, which was the only substance use behaviour in our study that ever was ‘normal’ in the statistical sense of the word. In 2012/2013, when the prevalence had dropped to 28%, depressive mood and three of the four behavioural measures (non-aggressive norm-violations, criminality and cannabis use) correlated significantly more strongly with this drinking outcome. The results were less consistent with respect to frequent intoxication (6+ times), which was not very common in 2002 (29%) and even less common in 2012/2013 (10%). Specifically, the associations between psychosocial problems and frequent intoxication were either significantly stronger on the latter assessment, or they showed no significant temporal changes. Cannabis use was low-prevalent in both 2002 (15%) and 2012/2013 (7%), and all the associations with psychosocial problems were approximately equally strong at both assessments.

Some other studies also indicate that the absolute magnitude of the changes in the prevalence of substance use matters. When the proportion of heavy drinking youth in Norway increased by 13 percentage points (from 26% in 1992 to 39% in 2002), the associations with delinquency and school misconduct became significantly weaker [28]. Studies that have focused on smaller absolute changes in the prevalence of adolescent substance use, have found none or inconsistent temporal changes in the strength of the

associations with psychosocial and/or behavioural problems [26,40,41]. For instance, a recent study showed that a range of such problems were approximately equally strongly related to cannabis use in a period when 11% had used the drug as compared to a period when the prevalence was 15% [42].

#### *A potential explanation*

One approach to explain variations in the strength of associations between deviant behaviour and substance use, as those observed in our study, is the following. Many risk factors for substance use (e.g. availability [43,44] and social norms [45,46]) may change over time, and thereby contribute to variations in the prevalence. Some shared intra-individual risk factors for substance use and behavioural problems (e.g. impulsivity and low self-control) [47] are—on the other hand—likely time-invariant, in part due to their genetic underpinning [48,49]. When the prevalence of substance use is low, such time-invariant influences will contribute more to the occurrence of substance use, than when the prevalence is high. Hence, their relative importance for the association between deviant behaviour and substance use will be larger when the prevalence is low, and vice versa. Evidently, substantial differences between ‘high’ and ‘low’ prevalence rates are required to detect significant changes in the strength of the associations between substance use and behavioural problems.

A similar line of reasoning was proposed by Talati and co-workers [50], whose study showed that the association between psychiatric disorders and smoking grew stronger as the proportion of smokers declined. Specifically, they noted that ‘as [...] smoking becomes

stigmatized, new smokers may increasingly be driven by biological or genetic vulnerabilities rather than social desirability'. Correspondingly, we found that the magnitude of the association between depressive mood and drinking to intoxication increased when the prevalence of getting drunk dropped markedly.

#### *The issue of reverse causality*

We argued that a strengthening of the link between psychosocial problems and substance use from 2002 to 2012/2013 would be indicative of a change in the recruitment base towards more deviant or vulnerable groups. However, it is possible that the experience of getting drunk tended to precede depressiveness and involvement in deviant behaviours, and that drinking to intoxication contributed to the psychosocial problems that we assessed.

On the other hand, such problems did not merely correlate with any and frequent intoxication (cf. Table 3) but also with *infrequent* intoxication (cf. Table 4), and it seems unlikely that only a few intoxication episodes contributed to depressive mood or school misconduct.

#### *Limitations*

It is possible that the extent of under- and over-reporting of alcohol and cannabis use was different at the two waves of data collection in our study. If so, this may have contributed to the observed decline. Generally, when low-prevalence phenomena are assessed, over-reporting may be a more serious threat to the validity than under-reporting [51,52]. One may, on the other hand, assume that the risk of over-reporting decreases when substance use becomes less prevalent and less socially acceptable. At any rate, if the respondents' willingness or ability to report their substance use fairly accurately was different in 2002 and 2012/2013, the comparability of the results would be affected.

Our measures on drinking behaviour were restricted to any and frequent intoxication episodes, and the amount of alcohol that is required to *feel* intoxicated may vary in a population across time. Such variations may reflect a change in the consumption level, as reported in a study from the USA [53]. The perception of what it takes to reach a state of intoxication may also have been different at the two waves of data collection in our study. Hence, it would have been advantageous if additional measures on alcohol use were included. The number of measures on psychosocial problems was also limited.

The sample sizes differed substantially between the two time points, and few demographic variables were available to test for possible sample differences. Finally, the response rate was higher in 2002 than in 2012/2013, and it is possible that the non-responders at the two assessments differed in important ways.

#### **Conclusion**

The assumption that psychosocial problems would be more closely related to adolescent substance use when the prevalence of the latter declined was only partly supported. Specifically, most of the associations with any intoxication episodes were stronger in 2012/2013 than in 2002, as were some of the associations with frequent intoxication. Psychosocial problems were approximately equally strongly related to cannabis use across time, which may reflect that the proportion reporting any use of the drug was fairly low even in the 'high-prevalence' period.

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#### **Conflict of Interest**

The authors have no conflicts of interest.

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