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Original article

Explaining Associations between Adolescent Substance Use and Condom Use

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Abstract

Purpose: This study examined different explanations for associations between adolescent substance use and lower condom use, in terms of the event-specific effects of alcohol or drugs, psychosocial factors, and sexual behaviors (intercourse frequency, greater number of partners and pill use).

Methods: Pupils from 25 schools in Scotland, UK provided data on use of alcohol, tobacco, cannabis and psychosocial factors at ages 14 and 16 years; and sexual behaviors at age 16 years. Logistic regression was used to examine associations between substance use and condom use in those reporting intercourse more than once (n = 1322), adjusting for explanatory variables.

Results: Regular use of any of the three substances at age 14 or 16 was associated with lower condom use at age 16, adjusting for gender and social background. The greatest attenuation of the substance use odds ratios was achieved by adjusting for all behaviors and psychosocial factors. This finding applied to different substance use groups, although cigarette-only and alcohol-only groups at age 16 differed in the relative importance of being "drunk or stoned" to other factors explaining condom use.

Conclusions: Among adolescent substance users, being "drunk or stoned" at intercourse was only one factor related to not using condoms. Psychosocial factors (including attitudes to sexual risks and peer sexual norms) and having more sexual partners also explained substance users' condom use, with lesser effects due to greater intercourse frequency and pill use. Multiple explanations for substance use/condom use associations may guide counseling and education services.

Keywords: Adolescent; Alcohol; Cannabis; Drugs; Cigarette; Condom; Sexual risk; Psychosocial; Longitudinal

Adolescent substance use appears to be an early indicator of sexual risk, as several studies have shown a longitudinal association between different types of substance use (tobacco, alcohol and illicit drugs) and sexual risk 2–14 years later, including risky behaviors (early sexual debut, low condom use, multiple sexual partners) and health outcomes (sexually transmitted infections and early pregnancy) [1–9]. Greater understanding of the links between substance use and sexual risk will help shape future intervention programs. Current explanations for the associations between substance use and sexual risk may be divided into two main types. The first is based on psychosocial risk factors underlying both problem behaviors, and the second focuses on the effects of alcohol or illicit drugs at the time of intercourse.

Research on psychosocial factors suggested by Jessor's problem behavior theory [10] has suggested that factors such as parental control, peer influences, attitudes toward school, religiosity, self-esteem, and other aspects of personality are associated with both substance use and sexual risk

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behaviors [11–17]. Such studies do not consider the role of substance use at the time of intercourse. Even where early substance use is a marker of much later sexual risk, studies commonly show persistent or escalated substance use up to the point where sexual risk has been measured [2,7,9] and have pointed to associations between early substance use and sexual risk after controlling for a wide range of psychosocial covariates [8]. Use of alcohol and other illicit drugs may directly reduce perceptions of sexual risk through pharmacological impairment of information processing [18], although there is a need to take into account individual and cultural expectations of the risks of alcohol that may contribute to increased risk-taking regardless of pharmacological effects [19,20]. These mechanisms may explain both increased likelihood of intercourse with a casual partner and failure to use condoms. However, any temporal association of substance use with risky sexual behavior may reflect psychosocial risk factors for a particular "sexual lifestyle." Few event-level studies of the effects of alcohol use on condom use attempt to control for many psychosocial factors or additional aspects of sexual lifestyle [21].

This article explores possible factors underlying associations between adolescent use of tobacco, alcohol or cannabis at ages 14 and 16 and condom use at 16 years, using data from *SHARE*, a randomized control trial of school sex education [22]. Given that reporting of substance and condom use may vary with both gender and social background, these characteristics were controlled for. We investigated whether associations between substance and condom use may be understood in terms of reported effects of substances used at intercourse, and whether psychosocial factors and other sexual behaviors also help to explain the associations found. We examined whether explanations differ according to the type(s) of substances used regularly. The data set allowed us to explore a much wider range of potential explanatory variables than normally considered in studies focusing primarily either on psychosocial factors or on use of substances at intercourse.

Explanatory psychosocial factors modeled include individual attitudes toward sexual risk and peer sexual norms. Explanatory behaviors modeled include reported effects of using alcohol or drugs at intercourse, intercourse frequency, number of partners, and pill use. All these behaviors are associated with substance use and condom use. However, their combined effects on condom use may be complex and difficult to interpret. On the one hand, studies of adolescents and young adults show that greater intercourse frequency and number of partners are associated with sensation-seeking and mood enhancement [23,24], often suggested to promote both substance use and sexual risk-taking [16,25]. On the other hand, although condoms are the most commonly used adolescent contraceptive [26], more sexually active adolescents may substitute the pill for condoms. In addition, sexually transmitted infection risk may lead to more condom use with a casual rather than a steady partner [27], and any negative effects of alcohol on condom use may be suppressed with a casual partner [28].

Methods

Data set

Following approval by Glasgow University's Ethical Committee for Non-Clinical Research Involving Human Subjects, all 47 nondenominational state schools within 24 km of the main cities in Tayside and Lothian regions of Scotland, UK (excluding pilot schools) were invited to participate in the *SHARE* randomized control trial of enhanced school-based sex education [22]. Twenty-five schools participated during 1996–1999. The main reason given for school nonparticipation was practical difficulties envisaged in program implementation. All pupils in a year-group were invited to take part (n = 8430). At baseline (n = 7616, mean age 14 years, 2 months) and follow-up (n = 5854, mean age 16 years, 1 month), pupils provided information about substance use and sexual behavior in a confidential self-completed questionnaire administered by researchers in examination conditions. This analysis was based on the maximum sample of 5356 adolescents who provided information at both ages. Both arms of the trial were combined after no significant effects of the intervention on the main measures were found. The baseline sample resembled 1991 Census data for Scotland, in terms of parents' social class and the proportion of one-parent households [29]. Data were weighted to compensate for attrition from baseline to follow-up, the attrition being mainly attributable to lower participation among school leavers completing postal questionnaires. Baseline information was used to develop a predictor of follow-up participation. The variables included in the weighting were gender, social class, family composition, parental monitoring, spending money, early school leaving, and drunkenness. This predictor was then used to calculate an inverse probability weight.

Demographic information is shown in Table 1. Boys and those from professional/managerial social classes, more affluent neighborhoods and two-parent families were less likely to report sexual experience.

Main measures

Outcome measures

The two main outcomes, self-reported at age 16 years by those reporting intercourse more than once, were no condom used at most recent sexual intercourse and incomplete condom use in the past 12 months. The latter binary measure was derived from the ratio of number of times a condom was used in the last 12 months to the frequency of intercourse during this period, both reported using a seven-point scale (0, 1, 2, 3, 4–6, 7–9, 10 or more). A ratio of less than one was defined as "incomplete condom use." This showed good agreement with a binary measure of condom

Table 1
Demographic composition, substance use and sexual behavior: *SHARE* sample completing both waves of survey

	All		Sexually experienced by age 16	
	n	%	n	%
Base for demographic composition and substance use	5356		2001	
Demographic composition				
Gender				
Boys	2514	48.8	823	43.9
Girls	2842	51.2	1178	56.1
Ethnic group				
White	4896	96.0	1789	97.4
Indian/Pakistani/Bangladeshi	89	1.8	15	0.8
Other	117	2.3	31	1.8
Parental social class				
Professional/managerial	2315	46.2	708	38.5
Skilled	1957	42.5	765	47.1
Semi-skilled/unskilled	498	11.2	228	14.4
Home neighborhood deprivation				
More affluent (DEPCAT 1–3)	2754	51.7	854	42.1
More deprived (DEPCAT 4–7)	2270	48.3	1033	57.9
Family structure				
Live with both parents	3857	70.5	1208	60.2
Live with one or neither parent	1301	29.5	644	39.8
Regular substance use at age 14 and 16 years				
Substance use at age 14 years				
No regular substance use	4134	78.0	1243	61.1
Regularly smoke cigarettes	516	13.7	397	24.4
Drunk once a week or more	707	16.8	501	29.9
Regularly use cannabis	105	2.8	84	5.5
Regular use of 1 substance only	595	13.7	381	21.9
Regular use of 2–3 substances	301	8.3	251	17.0
Substance use at age 16 years				
No regular substance use	3131	59.6	625	32.6
Regularly smoke cigarettes	1039	23.0	722	42.9
Drunk once a week or more	1418	28.8	863	47.1
Regularly use cannabis	269	5.9	191	11.3
Regular use of 1 substance only	1261	26.2	696	39.5
Regular use of 2–3 substances	640	14.2	467	27.8
Sexual behavior at age 16 years				
Intercourse experience				
Sexual intercourse	2001	42.4		
Sexual intercourse more than once: base sample used	1450		1450	
Frequency of intercourse in last 12 months				
0			71	4.7
1			87	6.0
2			169	11.1
3			154	10.5
4			228	16.6
7–9			109	7.9
10+			595	43.2
Number of sexual partners in last 12 months				
None			31	2.7
1			362	35.8
2			335	32.3
3			146	15.8
4			58	5.8
5			24	2.5
6+			51	5.2
Incomplete condom use in last 12 months				
No			902	61.4
Yes			501	38.6

Table 1
Continued

	All		Sexually experienced by age 16	
	n	%	n	%
No use of condoms at most recent intercourse				
No			879	59.0
Yes			553	41.0
"Drunk or stoned" at most recent intercourse				
No			1,094	75.2
Yes			341	24.8
Ever "drunk or stoned" at first intercourse, at first intercourse with most recent partner or at most recent intercourse				
No			782	53.5
Yes			663	46.5
Use of contraceptive pill (ever used)				
Never			720	52.4
Not very often			107	8.5
About half the time			122	9.1
Most of the time			177	13.9
Always			194	16.1

Note: percentages are based on weighted data, and exclude cases with missing information.

use during the respondent's entire sexual history ("always"/not "always"), chi-square = 539.0, df = 1, $p < .0001$.

Independent variables

The three most common types of regular substance use self-reported at both ages 14 and 16 years, cigarette smoking, cannabis use and being drunk once a week or more, were examined in relation to the sexual risk outcomes. Regular smoking and cannabis use were both the highest usage point on a four-point scale ("never tried," "tried," "use occasionally," "use regularly"). The alcohol measure, here termed "regular" alcohol use, was correlated (r = .67, $p < .000$) in a pilot study with self-reported amount consumed, and represented the two highest points on a five-point scale ("never drunk," and drunk "once or twice a year," "about once a month," "about once a week," or "more than once a week").

Social background measures comprised parental social class and deprivation. Social class (professional/managerial, skilled or semi-/unskilled) was coded using "Computer Assisted Standard Occupational Coding" (CASOC). CASOC software implements the Standard Occupational Classification introduced in the UK in 1990, and used in the main official sources of occupational information including the Labour Force Survey, New Earnings Survey, 1991 Census of Population, Family Expenditure Survey and the recording of job vacancies by the Employment Service [30]. Home postcode deprivation category scores (DEPCAT 1–3 or 4–7, where 1 is most affluent and 7 is most deprived) for Scottish postcode sectors were calculated from Carstairs scores, based on a combination of four variables derived from 2001 census small area statistics relating to overcrowding, male unemployment, low social class and car ownership [31]. Family structure was not found to predict condom use independently of social class or deprivation, so was not used in adjusting for social background.

The effects on substance use/condom use associations of four behaviors self-reported at age 16 years were investigated: all had significant ($p < .05$) associations with condom use and with age 14 and age 16 regular use of any substance. The measures comprised frequency of intercourse (see above for scale), number of partners over the past 12 months (converted to a binary measure of 1–2, or 3+ partners), pill use over entire sexual history (five-point scale from 1 = "never" to 5 = "always") and "drunk or stoned" at intercourse (two measures of the self-reported effects of substance use at intercourse). For models of no condom used at most recent intercourse, a measure "drunk or stoned" at intercourse was used. For models of incomplete condom use in the last 12 months, a measure "ever drunk or stoned" (at any of the following occasions: first intercourse, first intercourse with most recent partner, and most recent intercourse) was used.

Existing literature and *SHARE* findings [29,32,33] guided selection of psychosocial variables predicting condom use, which were also tested for further significant ($p < .05$) associations with age 14 and age 16 regular use of any substance. A mixture of psychosocial variables self-reported at age 14 and 16 were used together. Only psychosocial variables that were significant ($p < .05$) for each condom use outcome in multivariate analysis were included in final models. These variables comprised school achievement, expectations of early childbearing, peer sexual norms, and individual attitudes to sexual risk-taking and responsibility.

Table 2
No condom use reported at age 16 for substance users at ages 14 and 16 in the *SHARE* data set: results of separate models for each substance type n = 1322

	n in Substance group	% in Substance group	Incomplete condom use in last 12 months		No condom used at most recent intercourse	
			Unadjusted Odds ratio (95% CI)	Adjusted for gender and social background Odds ratio (95% CI)	Unadjusted Odds ratio (95% CI)	Adjusted for gender and social background Odds ratio (95% CI)
Longitudinal associations						
Regular substance use at age 14 years						
No regular use of cigarettes, alcohol or cannabis	803	57.2	1.00	1.00	1.00	1.00
Group 1 models						
Any substance used regularly	440	37.2	1.92 (1.49–2.46)	1.76 (1.38–2.25)	2.00 (1.58–2.52)	1.81 (1.42–2.30)
Group 2 models						
Cigarettes used regularly	275	24.3	2.00 (1.55–2.59)	1.81 (1.39–2.36)	1.95 (1.51–2.52)	1.72 (1.32–2.25)
Group 3 models						
Alcohol used regularly	350	29.7	1.56 (1.23–1.99)	1.44 (1.13–1.85)	1.76 (1.39–2.24)	1.61 (1.26–2.06)
Group 4 models						
Cannabis used regularly	56	5.1	1.30 (0.79–2.14)	1.43 (0.86–2.39)	1.67 (1.02–2.74)	1.92 (1.15–3.21)
Group 5 models						
1 substance used regularly	264	21.1	1.87 (1.41–2.48)	1.71 (1.28–2.28)	1.91 (1.44–2.52)	1.73 (1.29–2.30)
2–3 substances used regularly	176	16.1	1.98 (1.46–2.69)	1.83 (1.33–2.52)	2.12 (1.55–2.89)	1.93 (1.40–2.64)
Cross-sectional associations						
Regular substance use at age 16 years						
No regular use of cigarettes, alcohol or cannabis	403	28.3	1.00	1.00	1.00	1.00
Group 6 models						
Any substance used regularly	871	67.8	2.13 (1.63–2.76)	2.09 (1.60–2.73)	1.80 (1.39–2.33)	1.76 (1.35–2.29)
Group 7 models						
Cigarettes used regularly	565	45.9	1.86 (1.49–2.34)	1.74 (1.38–2.20)	1.72 (1.38–2.16)	1.57 (1.24–1.98)
Group 8 models						
Alcohol used regularly	647	48.3	1.67 (1.34–2.10)	1.76 (1.40–2.22)	1.31 (1.05–1.64)	1.38 (1.10–1.74)
Group 9 models						
Cannabis used regularly	138	10.9	1.64 (1.16–2.32)	1.98 (1.37–2.84)	1.98 (1.40–2.82)	2.51 (1.74–3.63)
Group 10 models						
1 substance used regularly	505	38.6	1.68 (1.26–2.24)	1.62 (1.21–2.18)	1.52 (1.15–2.02)	1.46 (1.10–1.95)
2–3 substances used regularly	366	29.1	2.89 (2.13–3.91)	2.92 (2.13–3.98)	2.24 (1.67–3.02)	2.24 (1.65–3.05)

Note: n Values are raw unweighted data. Dummies for categories with missing data not shown. Social background adjustments include social class and DEPCAT.

Table 3
Explaining associations between regular use of any substance (cigarettes, alcohol or cannabis) at age 14 years and condom use: effects of adjusting for sexual behaviors and psychosocial factors (n = 1322)

	n in Category	% in Category	Odds ratios (95% CI) Stage 1 Adjusted for gender and social background	Stage 2 1 + drunk/stoned at intercourse
Associations between regular use of any substance at age 14 and incomplete condom use in last 12 months, age 16 years				
Substance use at age 14				
No regular use of alcohol/cigarettes/cannabis	803	57.2	1.00	1.00
Regular use of one or more:alcohol/cigarettes/cannabis	440	37.2	1.76 (1.38–2.25)	1.54 (1.22–1.94)
Structural factors				
Gender				
Boys	478	38.3	1.00	1.00
Girls	844	61.7	1.49 (1.21–1.83)	1.49 (1.19–1.87)
Social class				
Professional/managerial	494	33.0	1.00	1.00
Skilled	548	42.6	1.61 (1.18–2.20)	1.64 (1.17–2.29)
Semi-skilled/unskilled	166	13.4	1.81 (1.17–2.83)	1.91 (1.20–3.02)
Home neighborhood deprivation				
More affluent (DEPCAT 1–3)	587	41.6	1.00	1.00
More deprived (DEPCAT 4–7)	656	52.6	1.52 (1.14–2.03)	1.55 (1.16–2.08)
Behavior measured at age 16 years				
Ever “drunk/stoned” at intercourse				
No	711	53.4		1.00
Yes	606	46.3		1.79 (1.41–2.29)
Frequency of intercourse in last 12 months				
Increasing	1322	Scale		
3 or more sexual partners in last 12 months				
No	890	67.1		
Yes	270	21.9		
Pill use				
Increasing	1322	Scale		
Psychosocial factors measured at age 14 years				
Expect to have child by age 18 years				
Not likely	1122	83.5		
Likely	173	14.6		
“Pregnancy is a risk you have to take to enjoy sex”				
Don’t agree	1113	83.0		
Agree	180	14.4		
Psychosocial factors measured at age 16 years				
Standard grades				
1 or more at credit level	874	60.8		
None at credit level	448	39.2		
Expect to have child by age 18				
Not likely	1215	90.5		
Likely	87	7.7		
“Pregnancy is a risk you have to take to enjoy sex”				
Don’t agree	1202	89.8		
Agree	109	9.4		
“It’s important to plan protection against pregnancy/STIs”				
High agreement	1193	89.7		
Low/medium agreement	103	8.2		
Personally responsible for condoms				
Agree	1131	84.7		
Don’t agree	136	11.6		
16-year-olds at school have had sex				
Less than half	495	33.8		
Most	809	64.8		
Friends				
Most still at school	886	60.8		
Most left school	413	37.4		
Associations between regular use of any substance at age 14 and incomplete condom use in last 12 months, age 16 years				
Friends would use condoms				
Agree	894	65.9		
Don’t agree	301	24.8		

Stage 3 2+ frequency of intercourse	Stage 4 3+ number of partners	Stage 5 4+ pill use	Stage 6 1+ all psychosocial factors	Stage 7 Adjusted for all sexual behaviors and psychosocial factors
1.00	1.00	1.00	1.00	1.00
1.44 (1.12–1.85)	1.41 (1.09–1.82)	1.37 (1.06–1.77)	1.38 (1.06–1.81)	1.12 (.84–1.48)
1.00	1.00	1.00	1.00	1.00
1.46 (1.14–1.86)	1.51 (1.20–1.90)	1.49 (1.16–1.91)	1.90 (1.44–2.51)	1.88 (1.42–2.49)
1.00	1.00	1.00	1.00	1.00
1.63 (1.23–2.15)	1.64 (1.15–2.35)	1.62 (1.23–2.14)	1.25 (.92–1.68)	1.26 (.93–1.72)
1.91 (1.30–2.81)	2 (1.24–3.23)	2.00 (1.36–2.93)	1.28 (.84–1.96)	1.40 (.91–2.15)
1.00	1.00	1.00	1.00	1.00
1.42 (1.06–1.91)	1.53 (1.13–2.07)	1.50 (1.17–1.92)	1.22 (.93–1.59)	1.23 (.94–1.62)
1.00	1.00	1.00		1.00
1.93 (1.51–2.45)	1.73 (1.37–2.18)	1.76 (1.38–2.25)		1.76 (1.34–2.32)
1.11 (1.04–1.20)	1.08 (.99–1.18)	1.07 (.99–1.15)		1.07 (.99–1.17)
	1.00	1.00		1.00
	1.93 (1.48–2.52)	1.94 (1.45–2.59)		1.68 (1.22–2.30)
		1.09 (1.01–1.17)		1.10 (1.01–1.20)
			1.00	1.00
			1.71 (1.18–2.48)	1.67 (1.14–2.44)
			1.00	1.00
			1.39 (.96–2.00)	1.41 (.97–2.05)
			1.00	1.00
			1.42 (1.08–1.87)	1.47 (1.11–1.95)
			1.00	1.00
			1.83 (1.11–3.02)	1.93 (1.17–3.21)
			1.00	1.00
			2.36 (1.47–3.79)	2.38 (1.47–3.84)
			1.00	1.00
			1.53 (.95–2.45)	1.46 (.90–2.36)
			1.00	1.00
			3.55 (2.24–5.63)	3.39 (2.12–5.41)
			1.00	1.00
			1.34 (1.01–1.78)	1.33 (1.00–1.77)
			1.00	1.00
			1.44 (1.10–1.88)	1.24 (.94–1.64)
			1.00	1.00
			2.41 (1.83–3.18)	2.42 (1.83–3.21)

Table 3
Continued

	n in Category	% in Category	Odds ratios (95% CI) Stage 1 Adjusted for gender and social background	Stage 2 1 + drunk/stoned at intercourse
Associations between regular use of any substance at age 14 and no condom used at most recent intercourse, age 16				
Substance use at age 14 years				
No regular use of alcohol/cigarettes/cannabis	803	57.2	1.00	1.00
Regular use of one or more:alcohol/cigarettes/cannabis	440	37.2	1.81 (1.42–2.30)	1.70 (1.33–2.16)
Structural factors				
Gender				
Boys	478	38.3	1.00	1.00
Girls	844	61.7	1.77 (1.39–2.25)	1.83 (1.43–2.33)
Social class				
Professional/managerial	494	33.0	1.00	1.00
Skilled	548	42.6	1.44 (1.10–1.89)	1.42 (1.08–1.86)
Semi-skilled/unskilled	166	13.4	1.44 (.99–2.09)	1.45 (1.00–2.11)
Home neighborhood deprivation				
More affluent (DEPCAT 1–3)	587	41.6	1.00	1.00
More deprived (DEPCAT 4–7)	656	52.6	1.55 (1.22–1.97)	1.57 (1.23–2.01)
Behavior measured at age 16 years				
"Drunk/stoned" at intercourse				
No	1007	75.3		1.00
Yes	307	24.1		1.64 (1.25–2.14)
Frequency of intercourse in last 12 months				
Increasing	1322	Scale		
3 or more sexual partners in last 12 months				
No	890	67.1		
Yes	270	21.9		
Pill use				
Increasing	1322	Scale		
Psychosocial factors measured at age 16 years				
Standard grades				
1 or more at credit level	874	60.8		
None at credit level	448	39.2		
Expect to have child by age 18 years				
Not likely	1215	90.5		
Likely	87	7.7		
"Pregnancy is a risk you have to take to enjoy sex"				
Don't agree	1202	89.8		
Agree	109	9.4		
Personally responsible for condoms				
Agree	1131	84.7		
Don't agree	136	11.6		
Friends				
Most still at school	886	60.8		
Most left school	413	37.4		
Friends would use condoms				
Agree	894	65.9		
Don't agree	301	24.8		

Stage 3 2+ frequency of intercourse	Stage 4 3+ number of partners	Stage 5 4+ pill use	Stage 6 1+ all psychosocial factors	Stage 7 Adjusted for all sexual behaviors and psychosocial factors
1.00 1.57 (1.23–2.02)	1.00 1.53 (1.19–1.97)	1.00 1.44 (1.12–1.85)	1.00 1.48 (1.14–1.93)	1.00 1.19 (.90–1.56)
1.00 1.77 (1.39–2.26)	1.00 1.80 (1.41–2.31)	1.00 1.78 (1.39–2.28)	1.00 2.15 (1.64–2.80)	1.00 2.18 (1.65–2.87)
1.00 1.43 (1.09–1.89) 1.49 (1.02–2.17)	1.00 1.44 (1.09–1.90) 1.52 (1.04–2.23)	1.00 1.39 (1.05–1.84) 1.51 (1.03–2.22)	1.00 1.19 (.89–1.58) 1.11 (.74–1.68)	1.00 1.19 (.88–1.61) 1.17 (.76–1.80)
1.00 1.57 (1.23–2.01)	1.00 1.57 (1.22–2.01)	1.00 1.51 (1.18–1.94)	1.00 1.28 (.99–1.67)	1.00 1.23 (.89–1.70)
1.00 1.91 (1.45–2.53)	1.00 1.79 (1.35–2.37)	1.00 1.94 (1.45–2.59)		1.00 1.86 (1.36–2.56)
1.22 (1.14–1.31)	1.19 (1.11–1.28)	1.15 (1.07–1.24)		1.16 (1.06–1.26)
	1.00 1.57 (1.18–2.10)	1.00 1.59 (1.19–2.14)		1.00 1.49 (1.08–2.04)
		1.21 (1.12–1.31)		1.24 (1.14–1.35)
			1.00 1.24 (.95–1.62)	1.00 1.28 (.96–1.69)
			1.00 2.02 (1.25–3.25)	1.00 2.07 (1.27–3.39)
			1.00 1.57 (1.01–2.46)	1.00 1.56 (.98–2.47)
			1.00 3.87 (2.47–6.06)	1.00 3.81 (2.39–6.06)
			1.00 1.44 (1.11–1.87)	1.00 1.15 (.87–1.53)
			1.00 3.87 (2.47–6.06)	1.00 2.85 (2.14–3.80)

Note: n values are raw unweighted data. Dummies for categories with missing data not shown.

Fewer psychosocial variables were significantly ($p < .05$) associated with no condom used at most recent intercourse: those that were not significant were excluded from the analysis for this outcome.

Table 4
Explaining associations between regular use of any substance (cigarettes, alcohol or cannabis) at age 16 and condom use: effects of adjusting for sexual behaviours and psychosocial factors (n = 1322)

	n in Category	% in Category	Odds ratios (95% CI) Stage 1 Adjusted for gender and social background	Stage 2 1+ drunk/stoned at intercourse
Associations between regular use of any substance at age 16 and incomplete condom use in last 12 months, age 16 years				
Substance use at age 16 years				
No regular use of alcohol/cigarettes/cannabis	403	28.3	1.00	1.00
No regular use of one or more:alcohol/cigarettes/cannabis	871	67.8	2.09 (1.60–2.73)	1.71 (1.29–2.28)
Structural factors				
Gender				
Boys	478	38.3	1.00	1.00
Girls	844	61.7	1.56 (1.23–1.98)	1.55 (1.22–1.97)
Social class				
Professional/managerial	494	33.0	1.00	1.00
Skilled	548	42.6	1.61 (1.23–2.12)	1.63 (1.24–2.15)
Semi-skilled/unskilled	166	13.4	1.77 (1.22–2.57)	1.86 (1.28–2.71)
Home neighborhood deprivation				
More affluent (DEPCAT 1–3)	587	41.6	1.00	1.00
More deprived (DEPCAT 4–7)	656	52.6	1.60 (1.25–2.04)	1.61 (1.26–2.05)
Behavior measured at age 16 years				
Ever "drunk/stoned" at intercourse				
No	711	53.4		1.00
Yes	606	46.3		1.67 (1.31–2.13)
Frequency of intercourse in last 12 months				
Increasing	1322	Scale		
3 or more sexual partners in last 12 months				
No	890	67.1		
Yes	270	21.9		
Pill use				
Increasing	1322	Scale		
Psychosocial factors measured at age 14 years				
Expect to have child by age 18 years				
Not likely	1122	83.5		
Likely	173	14.6		
"Pregnancy is a risk you have to take to enjoy sex"				
Don't agree	1113	83.0		
Agree	180	14.4		
Psychosocial factors measured at age 16 years				
Standard grades				
1 or more at credit level	874	60.8		
None at credit level	448	39.2		
Expect to have child by age 18 years				
Not likely	1215	90.5		
Likely	87	7.7		
"Pregnancy is a risk you have to take to enjoy sex"				
Don't agree	1202	89.8		
Agree	109	9.4		
"It's important to plan protection against pregnancy/STIs"				
High agreement	1193	89.7		
Low/medium agreement	103	8.2		
Personally responsible for condoms				
Agree	1131	84.7		
Don't agree	136	11.6		
16-year-olds at school have had sex				
Less than half	495	33.8		
Most	809	64.8		
Friends				
Most still at school	886	60.8		
Most left school	413	37.4		
Friends would use condoms				
Agree	894	65.9		
Don't agree	301	24.8		

Stage 3 2+ frequency of intercourse	Stage 4 3+ number of	Stage 5 4+ pill use	Stage 6 1+ all psychosocial factors	Stage 7 Adjusted for all sexual behaviors and psychosocial factors
1.00 1.69 (1.27–2.24)	1.00 1.58 (1.18–2.11)	1.00 1.61 (1.20–2.16)	1.00 1.49 (1.11–2.00)	1.00 1.16 (.85–1.60)
1.00 1.50 (1.18–1.92)	1.00 1.54 (1.21–1.97)	1.00 1.52 (1.18–1.94)	1.00 1.94 (1.48–2.56)	1.00 1.88 (1.42–2.49)
1.00 1.64 (1.25–2.16) 1.89 (1.29–2.77)	1.00 1.64 (1.24–2.16) 1.96 (1.34–2.87)	1.00 1.60 (1.21–2.13) 1.94 (1.32–2.86)	1.00 1.24 (.92–1.68) 1.27 (.83–1.94)	1.00 1.26 (.93–1.71) 1.39 (.90–2.14)
1.00 1.60 (1.25–2.05)	1.00 1.57 (1.23–2.02)	1.00 1.45 (1.10–1.93)	1.00 1.24 (.95–1.63)	1.00 1.23 (.93–1.62)
1.00 1.78 (1.39–2.27)	1.00 1.64 (1.27–2.11)	1.00 1.67 (1.29–2.16)		1.00 1.74 (1.32–2.30)
1.13 (1.05–1.21)	1.09 (1.02–1.17)	1.07 (0.99–1.15)		1.08 (.99–1.17)
	1.00 1.85 (1.38–2.47)	1.00 1.86 (1.39–2.48)		1.00 1.66 (1.21–2.28)
		1.09 (1.01–1.18)		1.10 (1.01–1.20)
			1.00 1.73 (1.20–2.51)	1.00 1.68 (1.15–2.45)
			1.00 1.54 (1.15–2.06)	1.00 1.39 (.96–2.02)
			1.00 1.41 (1.07–1.86)	1.00 1.47 (1.11–1.95)
			1.00 1.87 (1.13–3.08)	1.00 1.96 (1.18–3.26)
			1.00 2.28 (1.42–3.65)	1.00 2.31 (1.43–3.73)
			1.00 1.54 (1.15–2.06)	1.00 1.47 (.91–2.38)
			1.00 3.60 (2.28–5.70)	1.00 3.44 (2.15–5.49)
			1.00 1.54 (1.15–2.06)	1.00 1.32 (.99–1.76)
			1.00 1.45 (1.10–1.90)	1.00 1.26 (.95–1.67)
			1.00 2.37 (1.80–3.12)	1.00 2.41 (1.82–3.19)

Table 4
Continued

	n in Category	% in Category	Odds ratios (95% CI) Stage 1 Adjusted for gender and social background	Stage 2 1+ drunk/stoned at intercourse
Associations between regular use of any substance at age 16 and no condom used at most recent intercourse, age 16 years				
Substance use at age 16 years				
No regular use of alcohol/cigarettes/cannabis	403	28.3	1.00	1.00
Regular use of one or more:alcohol/cigarettes/cannabis	871	67.8	1.76 (1.35–2.29)	1.57 (1.20–2.06)
Structural factors				
Gender				
Boys	478	38.3	1.00	1.00
Girls	844	61.7	1.88 (1.48–2.38)	1.92 (1.51–2.45)
Social class				
Professional/managerial	494	33.0	1.00	1.00
Skilled	548	42.6	1.44 (1.10–1.89)	1.43 (1.09–1.87)
Semi-skilled/unskilled	166	13.4	1.41 (.97–2.05)	1.44 (.99–2.09)
Home neighborhood deprivation				
More affluent (DEPCAT 1–3)	587	41.6	1.00	1.00
More deprived (DEPCAT 4–7)	656	52.6	1.62 (1.28–2.07)	1.64 (1.28–2.09)
Behavior measured at age 16				
"Drunk/stoned" at intercourse				
No	1007	75.3		1.00
Yes	307	24.1		1.56 (1.19–2.05)
Frequency of intercourse in last 12 months				
Increasing	1322	Scale		
3 or more sexual partners in last 12 months				
No	890	67.1		
Yes	270	21.9		
Pill use				
Increasing	1322	Scale		
Psychosocial factors measured at age 16 years				
Standard grades				
1 or more at credit level	874	60.8		
None at credit level	448	39.2		
Expect to have child by age 18				
Not likely	1215	90.5		
Likely	87	7.7		
"Pregnancy is a risk you have to take to enjoy sex"				
Don't agree	1202	89.8		
Agree	109	9.4		
Personally responsible for condoms				
Agree	1131	84.7		
Don't agree	136	11.6		
Friends				
Most still at school	886	60.8		
Most left school	413	37.4		
Friends would use condoms				
Agree	894	65.9		
Don't agree	301	24.8		

Stage 3 2+ frequency of intercourse	Stage 4 3+ number of partners	Stage 5 4+ pill use	Stage 6 1+ all psychosocial factors	Stage 7 Adjusted for all sexual behaviors and psychosocial factors
1.00 1.53 (1.16–2.01)	1.00 1.46 (1.11–1.93)	1.00 1.45 (1.09–1.92)	1.00 1.33 (1.00–1.76)	1.00 1.15 (.85–1.56)
1.00 1.85 (1.45–2.36)	1.00 1.88 (1.47–2.40)	1.00 1.83 (1.43–2.34)	1.00 2.23 (1.71–2.91)	1.00 2.20 (1.68–2.89)
1.00 1.43 (1.09–1.89) 1.47 (1.00–2.14)	1.00 1.44 (1.09–1.90) 1.50 (1.03–2.20)	1.00 1.39 (1.05–1.84) 1.48 (1.01–2.18)	1.00 1.19 (.89–1.59) 1.10 (.73–1.67)	1.00 1.15 (.86–1.55) 1.13 (.74–1.73)
1.00 1.63 (1.28–2.09)	1.00 1.62 (1.26–2.08)	1.00 1.56 (1.21–2.00)	1.00 1.31 (1.01–1.71)	1.00 1.30 (.99–1.70)
1.00 1.82 (1.37–2.42)	1.00 1.73 (1.30–2.30)	1.00 1.87 (1.39–2.50)		1.00 1.88 (1.37–2.59)
1.23 (1.15–1.33)	1.21 (1.12–1.30)	1.16 (1.08–1.25)		1.17 (1.08–1.28)
	1.00 1.53 (1.15–2.05)	1.00 1.55 (1.15–2.08)		1.00 1.42 (1.04–1.95)
		1.22 (1.13–1.32)		1.25 (1.15–1.36)
			1.00 1.25 (.96–1.63)	1.00 1.30 (.99–1.72)
			1.00 2.03 (1.26–3.28)	1.00 2.01 (1.24–3.27)
			1.00 1.51 (.97–2.36)	1.00 1.57 (.99–2.48)
			1.00 3.92 (2.50–6.12)	1.00 3.75 (2.37–5.95)
			1.00 1.47 (1.13–1.91)	1.00 1.18 (.90–1.56)
			1.00 2.59 (1.97–3.41)	1.00 2.80 (2.11–3.71)

Note: n Values are raw unweighted data. Dummies for categories with missing data not shown.

Fewer psychosocial variables were significantly ($p < .05$) associated with no condom used at most recent intercourse: those that were not significant were excluded from the analysis for this outcome.

Statistical analysis

Logistic regression was used to model associations of substance use with the two condom use outcomes as alternative dependent variables. We adjusted for different sets of further independent variables, in order to examine which sets provided the greatest attenuation of odds ratios pertaining to substance use (referred to hereafter as "substance use odds ratios"). Multilevel analysis was carried out using MLwiN (Centre for Multilevel Modelling Team, University of Bristol, Bristol, UK) version 2.0, which took account of weighting and clustering by school. Dummies were created for missing categories of independent variables.

As previously stated, both condom use outcomes and intercourse frequency during the last 12 months were asked only of those reporting intercourse more than once (n = 1450). In order to be able to relate substance use reported at age 16 years to sexual experience in the recent past, this sample was further restricted to those reporting intercourse during the last 12 months (n = 1342). We did not include teenagers reporting intercourse once only, because our information on the timing of first intercourse in relation to this 12-month period was imprecise. The final models used a subset of the data (n = 1322) with complete information for both condom use outcomes.

Results

Rates of regular cigarette smoking, drunkenness and cannabis use at ages 14 and 16 in the *SHARE* data set are presented in Table 1. Two-fifths (42%) of respondents reported sexual intercourse by age 16 years. In this sexually experienced group, two-thirds (67%) were currently using substances regularly: 47% of these had reported regular substance use two years earlier at age 14 years. A high proportion of respondents (47%) reported being "drunk or stoned" on at least one of three episodes of intercourse.

Table 2 shows how each type of substance use was associated with condom use in separate models, before and after adjusting for gender and social background. Here the aim was to examine each substance type as an indicator of condom use, regardless of whether or not other substances were used in combination with the substance modeled. Both cigarette smoking and alcohol use at age 14 predicted lower condom use at age 16, although associations for the small group of age-14 cannabis users were not significant. All three types of substance use at age 16 were associated with lower likelihood of using condoms at this age. Use of two to three substances was associated with greater risk than use of one substance only, when the latter was set as a reference group ($p < .05$).

Girls and those from less affluent backgrounds were more likely to report not using condoms. There were gender differences in substance use, with girls more likely to smoke cigarettes and (at age 14) drink regularly, and boys more likely to use cannabis. Cigarette-smoking was most strongly associated with less affluent social background (results not shown). Adjusting for gender and social background reduced the odds ratios pertaining to regular use of any of the substances. Looking at each type of substance individually, odds ratios were reduced in the adjusted cigarette models and age-14 alcohol models, but not in the adjusted age-16 alcohol or any of the cannabis modaels. There were no significant interactions in any models for substance use with gender or social background.

We first examine explanations for associations between regular use of any of the three substances and condom use, before considering whether explanations may differ according to the type of substance(s) used.

Odds ratios pertaining to any substance use in models of condom use are presented in the top lines of Table 3 (age 14 substance use) and Table 4 (age 16 substance use). Each stage of the model represents a different set of adjustments, with stage one adjusting for gender and social background, and all subsequent stages including these adjustments. Stages two through five adjust for increasing numbers of behaviors, stage six for all psychosocial factors and stage seven for the full set of independents.

Being "drunk or stoned" at intercourse was not the only sexual behavior that attenuated the substance use odds ratios: extra attenuation was provided by the other behaviors (compare stages two and five). Frequency of intercourse and pill use had more effect on the substance use odds ratios in the models with age-14 substance use than in models with age-16 use.

Psychosocial factors produced a similar attenuation of the substance use odds ratios as the effect of combined behaviors (compare stages five and six). The greatest attenuation of the substance use odds ratios was produced by including all behaviors and psychosocial factors in the models (stage seven).

It is possible that the effect of explanatory variables could vary according to the type(s) of substances used. We hypothesize that being "drunk or stoned" at intercourse is likely to be less useful than other factors in explaining condom behavior among current cigarette smokers who are not also current regular users of alcohol or cannabis. This may not be true of cigarette-only users at 14 years, if they start to drink or use cannabis regularly by age 16 years.

We divided regular substance users into three groups at each age: cigarette smokers only, alcohol only, and combination users (any two, or all three substances—plus a very small number who regularly used cannabis only, who were too few to model separately). Cigarettes and alcohol were the most common combination, followed by use of all three substances.

All three groups were less likely to use condoms than those who were not regular substance users (see Table 5, stage one models). The odds of not using condoms were

Table 5
Explanations for associations between use of cigarettes, alcohol or cannabis and condom use: effect of substance type(s) used (n = 1322)

	n in Group	% in Group	Stage 1 Adjusted for gender and social background	Stage 2 Adjusted as stage 1 plus "drunk or stoned" at intercourse	Stage 3 Adjusted as stage 1 plus intercourse frequency, partners, pill use and psychosocial factors	Stage 4 Full model
			OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Models with substance use at age 14 years						
Regular substance use						
Outcome: Incomplete condom use in last 12 months						
No regular use	803	57.2	1.00	1.00	1.00	1.00
Only cigarettes used regularly	100	8.1	2.18 (1.43–3.33)	1.93 (1.26–2.96)	1.64 (1.01–2.65)	1.40 (.86–2.29)
Only alcohol used regularly	180	14.1	1.50 (1.07–2.09)	1.35 (0.97–1.90)	1.23 (.85–1.79)	1.09 (.74–1.60)
Combination of 2–3 substances used regularly	188	17.1	1.80 (1.33–2.45)	1.54 (1.12–2.12)	1.13 (.79–1.62)	1.01 (.70–1.46)
Outcome: No condom used at most recent intercourse						
No regular use	803	57.2	1.00	1.00	1.00	1.00
Only cigarettes used regularly	100	8.1	1.72 (1.13–2.62)	1.61 (1.05–2.46)	1.14 (.71–1.84)	.95 (.58–1.56)
Only alcohol used regularly	180	14.1	1.68 (1.21–2.34)	1.61 (1.15–2.25)	1.44 (1.00–2.07)	1.36 (.93–1.97)
Combination of 2–3 substances used regularly	188	17.1	1.86 (1.37–2.54)	1.76 (1.28–2.41)	1.21 (.85–1.72)	1.07 (.75–1.54)
Models with substance use at age 16 years						
Regular substance use						
Outcome: Incomplete condom use in last 12 months						
No regular use	403	28.3	1.00	1.00	1.00	1.00
Only cigarettes used regularly	207	17.4	1.61 (1.13–2.31)	1.47 (1.02–2.11)	.93 (.62–1.40)	.84 (.55–1.27)
Only alcohol used regularly	308	21.9	1.69 (1.21–2.36)	1.48 (1.05–2.10)	1.51 (1.04–2.19)	1.30 (.89–1.91)
Combination of 2–3 substances used regularly	388	30.8	2.96 (2.18–4.02)	2.39 (1.71–3.33)	1.79 (1.26–2.53)	1.42 (.97–2.07)
Outcome: No condom used at most recent intercourse						
No regular use	403	28.3	1.00	1.00	1.00	1.00
Only cigarettes used regularly	207	17.4	1.52 (1.07–2.16)	1.44 (1.01–2.06)	.96 (.64–1.42)	.89 (.60–1.34)
Only alcohol used regularly	308	21.9	1.46 (1.05–2.02)	1.33 (.95–1.86)	1.45 (1.01–2.09)	1.30 (.90–1.87)
Combination of 2–3 substances used regularly	388	30.8	2.37 (1.75–3.20)	2.08 (1.51–2.84)	1.60 (1.13–2.25)	1.35 (.94–1.93)

Notes: Combination groups contained two cases of "regular cannabis only" at age 14, and 11 cases of "regular cannabis only" at age 16 years; n values are raw unweighted data. Dummies for categories with missing data not shown.

greater for combination users than single substance users at age 16, but not at age 14.

As before, the greatest attenuation of all substance type odds ratios was seen with the inclusion of all psychosocial and behavioral factors in the models (stage four).

In the age-16 substance use models, there were differences in the effect of explanatory variables for the cigarettes-only and alcohol-only groups. Stage three (psychosocial variables and behaviors excluding "drunk/stoned" at intercourse) provided the greatest attenuation of the cigarettes-only odds ratios. The addition of being "drunk or stoned" at stage two produced some attenuation, presumably because the regular cigarettes-only group contained some occasional users of alcohol and drugs. However, being "drunk or stoned" at intercourse provided the greatest attenuation for alcohol-only odds ratios, especially at most recent intercourse. Combination users resembled the cigarette-only group, in that stage three variables had the most effect, but "being drunk or stoned" produced additional attenuation for combination users (compare stages three and four). In the age-14 substance use models, effects of explanatory variables were more similar across groups.

Discussion

Our data indicate that substance users' lower condom use appears more complex than simple explanations based on effects of drink or drugs at intercourse would suggest. A multifaceted model based on being "drunk or stoned" at intercourse, greater frequency of intercourse, more sexual partners, greater pill use, and psychosocial factors was a better explanation of why regular substance users failed to use condoms, particularly with adolescents using more than one substance regularly at age 16 years, who were found to be at greater sexual risk. This greater risk echoes results from other studies that have found sexual risk to increase with involvement in substance use [7,34,35]. There were indications that explanations for associations between substance use and condom use varied to some extent with substance type, and with the interval between the measurement of substance use and sexual behavior. It was, however, difficult to categorize adolescents according to substance type; and the data point to the need to consider both regular and more occasional substance use, and how these may change over time. Other studies confirm the need to consider trajectories of substance use in relation to sexual risk [2,4].

Limitations of the study include the reliability of self-reported data (including difficulties in interpreting the meaning of "regular" or "occasional" substance use). However, recent research suggests that reliability may be good for adolescent self-reported drinking and smoking [36,37]. There are also limitations in the measurement and coverage of the explanatory factors modeled. The factors are discussed in more detail below, but an important consideration is the nature of the psychosocial factors. Our data set did not contain factors related to a general risk-taking personality, which could have provided a more fundamental explanation for the associations between substance use and sexual risk (see, e.g., [17]). In this sense, our findings reflect empirical limitations, but the information on substance users' sexual behaviors, attitudes to sexual risks, and peer culture that we have been able to model may be of more practical use to educational, counseling, and health services than explanations couched in terms of a general "risk-taking" personality. Although attrition from age 14 to 16 was greater for groups more likely to report risk behaviors at age 16, weighting was used to help address this limitation, and together with the representativeness of the baseline sample makes it likely that the findings are generalizable to other adolescents in similar settings.

Several psychosocial factors including school achievement, peers' sexual norms, individual expectations and attitudes towards sexual risk and responsibility characterized the associations between regular substance use and condom use. Fewer psychosocial factors were significant in models of no condom at most recent intercourse than in models of incomplete condom use in the last 12 months. This may reflect both the lesser importance of the two age-14 measures for most recent intercourse, occurring further away in time from baseline than the 12-month period, as well as the greater influence of more partner-specific factors for a single episode of intercourse. The direction of any causation is problematical in cross-sectional associations, and Brook et al [5,6] have pointed to reciprocal relationships between substance use and risky sex, possibly mediated by peer groups or boy-/girlfriend relationships. Nevertheless, the psychosocial factors point to differences in the personality and peer culture of adolescents who combine substance use with sexual risk-taking.

Being "drunk or stoned" at intercourse was an important part of the explanation for regular substance users' failure to use condoms, although the extent of any cognitive impairment due to pharmacological effects remains unclear. The "ever drunk or stoned" measure was not strictly related to the 12-month period for incomplete condom use, so it may be more instructive to examine the effects of event-specific substance use at most recent intercourse. Here for regular drinkers-only at age 16, being "drunk or stoned" explained condom behavior as much as the model with all predictors included. Our finding may reflect the relatively young age of our subjects, because reviews suggest that drinking at intercourse is reliably associated with lower likelihood of condom use only in younger adolescents, and on losing virginity [21,38,39]. However, for the other substance type groups at age 16, the model with "drunk or stoned" alone was less successful in explaining condom behavior at most recent intercourse than models containing psychosocial variables and other sexual behaviors.

We lacked information on other event-specific substance use that did not necessarily make the user feel "drunk" or "stoned." This might have explained some of the effects of frequency of intercourse and number of partners, if substance use led directly to greater sexual activity. We also need to understand why a greater number of partners and intercourse frequency should both be associated with lower condom use. It is possible that both behaviors are indicators of greater "sensation-seeking," although this did not predict condom use in a recent diary study [40]. The effects of intercourse frequency were partly explained by adjusting for pill use, although the latter behavior had a small additional effect on longitudinal substance use/condom use associations. This suggested that some age-14 substance users who may have had a longer sexual history were substituting the pill for condoms.

The effect of greater number of partners on condom use apparently contrasts with findings for older adolescents, who were more likely to use condoms with "casual" partners [24,41]. We do not have information on all partners' "casual" or "main" status, and it is possible that sexually transmitted infection risk might have been salient only for those with larger numbers of "casual" sexually experienced partners, rather than a succession of fewer, less experienced "main" partners. With lesser experience in managing sexual relationships, the main effect of a less familiar partner could be greater difficulties over planning and negotiating contraception. Previous *SHARE* research found that condom use at first intercourse was lower for non-boy-/girlfriend relationships [29], and other research points to strong interrelationships between use of alcohol, casual sex, and lack of planning [39,42].

Our research points to the need to consider a range of factors that may contribute to substance users' sexual risk-taking behavior, particularly when adolescents use more than one type of substance. Further qualitative research to clarify causal mechanisms may help to understand more distal influences on sexual risk-taking by substance users, as well as more proximate influences such as using drinks or drugs at intercourse and engaging in more casual sex.

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