ORIGINAL CONTRIBUTION

Multiple substance use and self-reported suicide attempts by adolescents in 16 European countries

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Abstract Substance use and suicide attempts are high-risk behaviors in adolescents, with serious impacts on health and well-being. Although multiple substance use among young people has become a common phenomenon, studies of its association with suicide attempts are scarce. The present study examines the association between multiple substance use and self-reported suicide attempts in a large multinational sample of adolescent students in Europe. Data on multiple substance use (tobacco, alcohol, tranquillizers/sedatives, cannabis, other illegal drugs) and self-reported suicide attempts were drawn from the 2007 European School Survey Project on Alcohol and Other Drugs (ESPAD). The ESPAD survey follows a standardized methodology in all participating countries. The present study is based on 45,086 16-year-old adolescents from 16 countries that had used the optional "psychosocial module" of the questionnaire, thereby including the question on suicide attempts. Logistic regression analyses were performed to examine the associations of any self-reported suicide attempt (dependent variable) with substance use controlling for country and gender. The strongest association with self-reported suicide attempts was for any lifetime tranquillizer or sedative use (odds ratio 3.34, 95 % confidence interval 3.00–3.71) followed by any lifetime use of illegal drugs other than cannabis (2.41, 2.14–2.70), 30-day regular tobacco use (2.02, 1.84–2.21), 30-day frequent alcohol use (1.47, 1.32–1.63) and any 30-day cannabis use (1.37, 1.18–1.58). The odds ratio of reporting a suicide attempt approximately doubled for every additional substance used. These findings on the association between multiple substance use, including legal drugs (tranquillizers or sedatives and tobacco), and the life-threatening behavior of suicide attempts provide important cues for shaping prevention policies.

Keywords Multiple substance use · Suicide attempts · Adolescents · ESPAD survey

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Introduction

In the 27 European Union countries, suicide is second only to traffic accidents as the leading cause of death among young people aged 15–19 years old [8]. Similarly, the World Health Organization (WHO) ranks it as the second commonest cause of death among 15–35 year olds in

European Region countries and warns that "a dramatic increase in suicidal behavior is to be expected in the coming decades unless effective preventive measures are put in place" [40].

Previous suicide attempts are considered to be one of the most potent predictors of completed suicide in adolescents [4, 18]. Furthermore, attempted suicide by adolescents is an indicator of the presence of other personal or social problems such as emotional distress or mental health problems [31, 34] and family-related [33] or socioeconomic problems [13]. These problems need to be tackled promptly to prevent possible consequences in young adulthood [22].

Legal and illegal substance use has been reported to be among the major factors related to suicide attempts [1, 17, 25]. It is suspected that the expansion of the epidemic of drug use among young people in the USA and the UK is associated with increased suicides among young people in those countries [14]. Although trends in illegal drug use in young people and adolescents in western European countries appear to have levelled off in recent years, this stabilization is at the high levels that the epidemic reached since the mid 1980s. Furthermore, following the opening of borders in eastern Europe in 1999, a rapid rise in illegal drug use has been noted in several Eastern European countries [9].
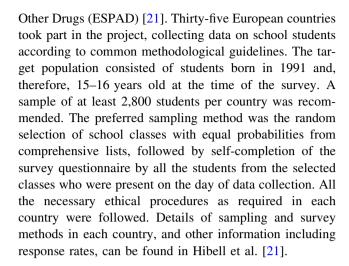
An increasingly common pattern of substance use among young people is the concurrent use of different psychoactive substances [10, 32]. It is documented that multiple substance use increases health risks, and that adolescents are the most vulnerable group to the toxic pharmacologic effects of substances [7].

Although there are published reports on the association between the use of specific substances and mental health problems, including depression and suicidal behaviors [26, 33], most of the existing literature on multiple substance use examines the risks associated with physical health. Studies on the associations between multiple substance use and psychological health are scarce. The purpose of the present paper is, therefore, to investigate the associations between multiple substance use and self-reported suicidal behavior among adolescents in a large sample from 16 European countries. We investigate not only the association between the use of specific substances and increased likelihood of reporting suicide attempts, but also the association of self-reported suicidal behavior with the number of substances used.

Methods

Sample

The analysis is based on data collected in the course of the 2007 European School Survey Project on Alcohol and Other Drugs (ESPAD) [21]. Thirty-five European countries took part in the project, collecting data on school students according to common methodological guidelines. The target population consisted of students born in 1991 and, therefore, 15–16 years old at the time of the survey. A sample of at least 2,800 students per country was recommended. The preferred sampling method was the random selection of school classes with equal probabilities from comprehensive lists, followed by self-completion of the survey questionnaire by all the students from the selected classes who were present on the day of data collection. All the necessary ethical procedures as required in each country were followed. Details of sampling and survey methods in each country, and other information including response rates, can be found in Hibell et al. [21].

Questionnaire

The survey instrument consisted of a core questionnaire which can be found in its English version in Hibell et al. [21] and four optional modules. Participating countries chose to use any number of the optional modules. The 16 countries (listed in Table 1) included in the present study, with a total sample of 45,086 students, were those that chose to administer the Psychosocial Module and consequently could provide data on self-reported suicide attempts, an item that is not in the core ESPAD questionnaire. One additional country, the Faroe Islands, had administered this module but lacked certain data on substance use and was, therefore, excluded. It is apparent from Table 1 that most of the larger European countries are not included in the study, notably France, Germany, Italy and Russia. However, the countries included in the study did not differ appreciably from the rest in levels of substance use: median prevalences of lifetime use were 17 % in participating countries and 21.5 % in non-participants for cannabis; 7 and 8 %, respectively, for other illegal drugs; and 4 and 7 %, respectively, for unprescribed use of tranquilizers or sedatives. Also, there was no noteworthy difference in rates of completed suicide at ages 15–19 years [8], with medians of 5.8 per 100,000 in participating countries and 7.7 in non-participants.

Measures

We defined polydrug use on the basis of the use of two or more out of five substances or categories of substances (tobacco, alcohol, unprescribed use of tranquilizers/sedatives, cannabis and other illegal drugs), within the last 30 days before the survey for tobacco, alcohol and cannabis, and at any time for tranquilizers/sedatives and illegal drugs other than cannabis (the ESPAD questionnaire asks only for lifetime use of substances in these two categories).

Table 1 Prevalence of substance use in 15–16 year old students in 16 European countries from the 2007 ESPAD survey

	n	Use in last 30 days			Any lifetime use	
		Tobacco >5 cigarettes per day (%)	Alcohol ≥10 times (%)	Cannabis at least once (%)	Other illegal drugs[a] (%)	Tranquillizers without prescription (%)
Armenia	4,055	1.7	2.3	0.8	1.8	0.4
Austria	2,571	18.8	29.7	6.3	10.6	2.1
Belgium (Flanders)	1,889	6.4	16.8	12.2	8.9	8.7
Bulgaria	2,353	21.8	12.5	7.3	8.8	2.8
Croatia	3,008	18.1	12.6	6.2	4.0	4.8
Cyprus	6,340	11.2	11.1	3.3	4.5	6.8
Greece	3,060	10.0	11.6	3.1	4.7	4.2
Hungary	2,817	11.5	6.7	5.3	7.7	9.0
Iceland	3,510	6.5	1.2	2.6	5.2	7.2
Isle of Man	740	9.3	16.4	15.4	16.4	6.5
Latvia	2,275	16.0	7.5	4.0	11.3	4.2
Romania	2,289	9.3	7.1	0.7	3.0	4.0
Slovakia	2,468	12.9	10.1	11.4	9.2	5.2
Slovenia	3,085	12.2	9.4	9.4	7.4	5.2
Ukraine	2,447	11.4	8.0	2.5	3.7	4.3
United Kingdom	2,179	7.9	13.7	11.0	8.6	1.8
Total[b]	45,086	11.3	10.3	5.4	6.3	4.8

[a] Amphetamines, ecstasy, hallucinogens, crack, cocaine, heroin

[b] Unweighted total

In order for the results not to be dominated by the use of tobacco and alcohol, which are easily available substances with which young people experiment and are largely influenced by environmental and socio-cultural factors, we set minimum levels of use in the last 30 days in order to identify those students who are adopting more clear-cut risk behaviors. Further details of the measures are as follows.

Tobacco

Use of tobacco was defined as smoking at least six cigarettes per day in the last 30 days. This was obtained from the question "How frequently have you smoked cigarettes during the last 30 days?" with responses on the seven-point scale "not at all/<1 per week/<1 per day/1–5 per day/6–10 per day/11–20 per day/>20 per day".

Alcohol

Use of alcohol was defined as drinking at least 10 times in the last 30 days. This was obtained from the question "On how many occasions (if any) have you had any alcoholic beverage to drink during the last 30 days?" with responses on the 7-point scale "0/1–2 times/3–5/6–9/10–19/20–39/ ≥40 times".

Cannabis

Use of cannabis was defined as reporting any use in the last 30 days, in response to the question "On how many occasions (if any) have you used marijuana or hashish (cannabis) during the last 30 days?" with the same seven-point response scale as for alcohol.

Other illegal drugs

Use of any other illegal drug was defined as any lifetime use of ecstasy, amphetamines, hallucinogens, crack, cocaine or heroin. The use of each one of these substances was established from the question "On how many occasions in your lifetime (if any) have you used any of the following drugs?" followed by a list of substances each requiring a response on the same seven-point scale as above.

Tranquillizers

Any lifetime use of tranquillizers or sedatives without prescription was taken from the same question as other illegal drugs. An earlier question had asked about their use under the direction of a doctor and included an explanation and examples of current commercial names of tranquillizers and sedatives.

Self-reported suicide attempts

Any self-reported suicide attempt was obtained by recoding the response to the item "Attempted suicide" in a multiple-part question in which "Has any of the following ever happened to you? If so, how many times?" was followed by three items: (a) "Run away from home for more than one day", (b) "Thought of harming yourself", and (c) "Attempted suicide". Each item was answered separately using the response scale "never/once/twice/3–4 times/5 or more times".

Statistical analysis

Logistic regression was used to examine associations between any self-reported suicide attempt (the dependent variable) and substance use. Gender and dummy variables for the countries were also included as independent variables along with substance use. A previous analysis of these data had shown that the interaction between country and gender had a significant effect on self-reported suicide attempts; therefore, these interaction terms were also included here [25].

In the main analysis, substance use was represented by dummy variables for the five substances separately. Interaction terms between the substances were also included to examine the possibility that combinations of substances could have effects different from the sum of their separate effects. In a supplementary analysis, substance use was represented by the number of substances used. This variable was alternatively treated as numerical or categorical. Likelihood ratio tests were employed to assess the statistical significance of terms in the regression. Because of the very large sample size, only results significant at the level $P = 0.01$ were taken into consideration. Analysis was performed using the svyset and svy logistic commands in the Stata package, which take account of the complex sample design (clustering into school classes).

Cases with missing data for the dependent variable or any of the independent variables were omitted from the analysis. Complete data on substance use were available for 43,664 students (96.8 %). An additional 1,029 students did not answer the question on suicide attempts, leaving 42,635 cases for analysis (94.6 % of the original sample).

Results

The prevalences of each of the five substances are shown for each country separately in Table 1. Overall, the prevalence of tobacco use and alcohol use at the levels we have selected is 11 and 10 %, respectively, with the other substances at about 5–6 %. However, there is wide variation between countries.

Table 2 shows the distribution of the number of substances used and also the prevalence of any self-reported

Table 2 Distribution of number of substances used and prevalence of any self-reported suicide attempt by 15–16 year old students in 16 European countries from the 2007 ESPAD survey

	Number of substances used (%)			Any suicide attempt (%)	Any suicide attempt (%) by number of substances used		
	0	1	2+		0	1	2+
Armenia	94.9	3.8	1.3	4.1	3.9	4.1	14.9
Austria	57.3	25.9	16.8	11.1	6.5	11.6	26.3
Belgium (Flanders)	68.1	19.4	12.5	6.4	3.1	11.4	15.1
Bulgaria	66.9	20.2	13.0	10.0	6.6	10.8	23.6
Croatia	69.8	20.0	10.2	8.4	5.2	10.8	25.9
Cyprus	75.7	16.4	8.0	14.9	10.2	20.4	43.3
Greece	77.4	15.1	7.5	12.5	9.9	16.1	30.7
Hungary	74.8	15.6	9.6	23.5	18.1	33.0	48.8
Iceland	85.7	8.9	5.4	10.5	6.9	26.7	42.0
Isle of Man	68.0	15.9	16.1	13.6	9.1	17.1	30.4
Latvia	72.0	18.3	9.7	14.2	10.7	15.9	37.9
Romania	81.3	14.9	3.8	10.1	8.1	14.8	32.5
Slovakia	70.3	17.5	12.2	7.4	4.8	11.1	17.3
Slovenia	72.4	17.3	10.2	12.5	9.2	17.1	28.8
Ukraine	78.4	15.7	5.8	7.5	6.1	10.1	18.3
United Kingdom	72.6	17.4	10.0	9.2	6.7	12.7	19.3
Total[a]	75.5	15.8	8.7	11.2	7.9	15.7	29.7

[a] Unweighted total

Table 3 Frequency distribution of combinations of substances used in the total sample: $n = 43,664$ students (96.8 % of the total sample) for whom all these data are available

Number of substances	Combination	n	%
None		32,961	75.5
One substance		6,896	15.8
	Tobacco	2,338	5.4
	Alcohol	2,306	5.3
	Cannabis	518	1.2
	Other drugs	770	1.8
	Tranquilizers	964	2.2
Two substances		2,358	5.4
	Tobacco + alcohol	773	1.8
	Tobacco + Cannabis	310	0.7
	Tobacco + other drugs	256	0.6
	Cannabis + other drugs	201	0.5
	Other combinations	818	1.9
Three substances		920	2.1
	Tobacco + Cannabis + other drugs	200	0.5
	Other combinations	720	1.6
Four substances		407	0.9
Five substances		122	0.3

suicide attempt, again separately for each country. The prevalence of any self-reported suicide attempt was 11.2 % overall and varied from 4.1 % in Armenia to 23.5 % in Hungary. In every country, the percentage of respondents who reported at least one suicide attempt increased steeply with the number of substances used. Overall, a quarter (24.5 %) of the students in this study claimed to have used at least one of the legal or illegal substances, according to our definitions; 15.8 % used only one and 8.7 % were polydrug users using two (5.8 %) or more (3.3 %) substances (Table 2). As expected, the commonest combination of at least two substances was tobacco and alcohol (Table 3).

Results of logistic regression are shown in Table 4. In the first analysis, the independent variables were the five separate substances in addition to gender, country and the gender-by-country interaction. The two-way interactions between the substances were not statistically significant (change in deviance 25.9 with 15 degrees of freedom, $P = 0.040$).

The use of tranquilizers without prescription had the strongest association with self-reported suicide attempts [odds ratio (OR) 3.34, 95 % confidence interval 3.00–3.71], followed by the use of other illegal drugs apart from cannabis (OR 2.41, 2.14–2.70). The third strongest association was with the use of tobacco (OR 2.02, 1.84–2.21). Odds ratios for the association with the use of alcohol (OR 1.47, 1.32–1.63) and cannabis (1.37, 1.18–1.58) were similar to each other and somewhat smaller than for the other substances.

In the second logistic regression analysis, the separate substances were replaced as independent variables by the

Table 4 Results of logistic regressions for any versus no self-reported suicide attempt

	Odds ratio	95 % confidence interval
First analysis		
Alcohol	1.47	1.32–1.63
Tobacco	2.02	1.84–2.21
Cannabis	1.37	1.18–1.58
Tranquilizers without prescription	3.34	3.00–3.71
Illegal drugs other than cannabis	2.41	2.14–2.70
Second analysis		
Number of substances (categorical)		
0	1	
1	2.39	2.20–2.60
2	4.47	4.00–4.99
3	7.42	6.33–8.69
4	11.6	9.41–14.3
5	31.0	20.9–46.1
Third analysis		
Number of substances (numerical)	1.98	1.92–2.05

All analyses include gender, country and the country-by-gender interaction in addition to substance use as independent variables

number of substances used, treated as a categorical variable. As would be expected from the widely different odds ratios for the individual substances in the first analysis, this model did not fit as well as the first model (change in

deviance 123.4), but the difference was relatively small considering the very large sample size. In other words, the number of substances used provided almost as strong an association with self-reported suicide attempts as the separate substances and their combination. Polydrug users had a greatly increased risk for self-reported suicide attempts compared to non-users. The odds ratio was 4.47 (4.00–4.99) for users of two substances and increased sharply with the use of additional substances (Table 4). In this analysis, the very wide confidence interval for the odds ratio for five substances arose because only 122 students used all five substances.

In a third logistic regression analysis, the number of substances was again used as an independent variable, but this time treated as a simple numerical measure. This entailed poorer fit than the previous model (change in deviance 34.6 with 4 degrees of freedom), but gave broadly the same results. The odds ratio for number of substance used was 1.98 (95 % confidence interval 1.92–2.05). This indicates that the odds of reporting any suicide attempt doubles for every additional substance used. This very simple model slightly underestimates the risk associated with the use of only one or two substances and it overestimates the risk associated with the use of four substances (Table 4). Although these models based on the number of substances used do not fit the data as well as models using the specific substances, they provide a rule of thumb for the increased risk associated with using additional substances.

Discussion

The findings from this study confirm the close association that has been reported between substance use and self-reported suicide attempts in adolescents [1, 11, 25, 28, 37]. Our analysis shows the relative importance of the type of substance used in relation to self-reported suicide attempts. The unprescribed use of pharmaceutical drugs, specifically in this case tranquillizers or sedatives, seems to have the strongest association with self-reported suicide attempts. Lynskey et al. [28] in their longitudinal study of Australian twins also reported that opioid/sedative and polydrug use had the highest odds ratios for suicide attempts. Tobacco was found to follow tranquillizers/sedatives and illegal drugs other than cannabis with respect to the size of its association with suicide attempts. This finding is in line with other reports showing that current tobacco use is associated with youth suicide attempts [24], while in another study nicotine dependence was found to be closely associated with suicidality among adolescent females [35].

The independence of the effects of the five substances in logistic regression shows that there is a strong association between self-reported suicide attempts and the degree of involvement with legal and illegal substances in terms of the number of substances used. This point is illustrated by our supplementary analyses in which we employed the number of different substances used as an independent variable. The conclusion from these analyses is that the odds of reporting any suicide attempt approximately doubles for every additional substance used, where "use" refers to the frequencies of lifetime or last month use defined earlier.

Both multiple substance use and suicide attempts constitute high-risk behaviors. The strong association between them documented by the present study is concordant with Jessor's and Jessor's problem behavior theory [23] according to which problematic behaviors in adolescents tend to appear together.

Findings from the present study have major relevance in the field of prevention of suicide risk among adolescents. Not only illegal drug use, but even more so the use of legal substances such as tobacco and tranquillizers or sedatives, is strongly associated with self-reported suicide attempts. Relatively easy access to tranquillizers or sedatives—commonly prescribed for the treatment of anxiety either directly to adolescents or to adult members of the family—and to tobacco might constitute factors contributing to their use. Both substances might also influence adolescent behavior through adult modeling [27].

Special attention should be paid to the impact of tobacco use, which is not only a common behavior in the general population, but also usually the first substance with which an adolescent initiates his or her substance use career. It has indeed been documented that preventing or delaying tobacco use in adolescents has a protective influence in preventing the use of illegal drugs—the "gateway theory" [12, 30, 39]. Our study shows that multiple substance use multiplies the risk of self-reported suicide attempts. We can, therefore, hypothesize that preventing tobacco use might exert a protective influence not only on progressing to more hazardous illegal drug use but also on suicide attempts.

Among the strengths of the ESPAD survey are its extensive multinational coverage and its careful methodological standardization which allow for the generalization of its conclusions. To our knowledge, ours is the only study reporting on the relationship of adolescent self-reported suicide attempts with multiple substance use in such a large number of countries. An additional strength is the assessment of the relative importance for self-reported suicide attempts of the specific substances used. Finally, among the strengths of our study is the documentation of the association of multiple substance use with self-reported suicide attempts on the basis of different analytical approaches. These analytical approaches could be utilized in future studies aiming to provide new insights into multiple drug use among adolescents.

A weakness of the study, in common with most school surveys, is its cross-sectional design. This does not permit ascertainment of the "true" direction of the apparent relationships between substance use and self-reported attempted suicides. However, the very young age (16 years old) of the study population suggests that a straightforward cause–effect relationship is unlikely. A two-way relationship or the existence of common underlying vulnerability factors such as a depressive disorder, poor impulse control or stressful life events [5, 28, 29] seems to be a more appropriate hypothesis in this case.

Finally the self-reported type of data could be considered as a limitation of our study. Concerning the data quality, it has been documented that in this age group anonymous self reports tend to elicit more valid data on sensitive issues compared to other methods [36]. Relevant studies on the topic include a large test–retest examination of the reliability of the Youth Risk Behavior Survey questionnaire in the USA, which contains similar questions to ESPAD on the use of substances within various time frames [2]. Clearly, far richer data would be obtained from a multi-informant study than can be obtained only from the students' own reports, but to obtain data also from parents and teachers is infeasible in a large-scale survey such as ESPAD.

Suicide attempts and substance use, similarly to other high-risk behaviors, are multi-factorial in nature, with individual and social components. The close association of both of these behaviors with completed suicide [19, 20, 40] and their comorbid relationship with other high-risk behaviors indicates that they should be considered as early signs of health-compromising outcomes and of an eventually lethal one. They should consequently be approached within the framework of a broader prevention strategy that combines early interventions aiming to decrease risk factors with the promotion of resilience [3]. Educating parents with regard to their modeling impact and parenting practices [6], and also physicians [38] with regard to their prescribing practices could constitute important components in prevention along with the implementation in schools of preventive programmes aiming to improve the psychological wellbeing of students [16]. As stated by Gore et al. [15] in their analysis of the global burden of disease in young people, "the health of young people has been largely neglected in global public health because this age group is perceived as healthy… Adolescent health would benefit from increased public health attention".

Conclusion

The findings from the present study confirm the strong association between substance use and self-reported suicide attempts and show the relative size of these associations for different legal and illegal drugs. The strength of the association increases in parallel with the increasing number of substances used. The use of tranquillizers and sedatives without prescription had the strongest association with self-reported suicide attempts, followed by illegal drugs (other than cannabis) and tobacco. These findings indicate that strategies for suicide prevention in adolescents should not be limited to illegal drugs but should extend their focus to the use of tranquillizers, sedatives and tobacco.

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