CROATIAN MEDICAL JOURNAL
CMJ

44(1):50-58,2003

STUDENT *CMJ*

Use of Psychoactive Substances among Zagreb University Medical Students: Follow-up Study

Vladimir Trkulja, Želimir Živčec, Mario Ćuk, Zdravko Lacković

Department of Pharmacology, Zagreb University School of Medicine, Zagreb, Croatia

Aim. To estimate the exposure of Zagreb University medical students to psychoactive substances in 2000 and compare it with data collected in 1989.

Methods. Students were surveyed in 2000 (n = 775) and 1989 (n = 986) by means of a self-reporting questionnaire. The 2000 survey also included 136 non-medical students. General demographic data and data on experience with psychoactive substances were collected, analyzed, and presented as percentages with 95% CI.

Results. The lifetime prevalence of contact with illicit drugs (mostly marijuana) among medical students in 2000 was 35% vs 14% in 1989. Repeated use was reported by 3.9% students, and 6% confirmed the experience of simultaneous use of alcohol and drugs. The lifetime prevalence of contact with psychoactive medications (mostly benzodiazepines) was 33% in 2000 vs 15% in 1989. Medications were largely used without medical supervision, with 3.5% of the students explicitly stating non-medical reasons for consumption. The prevalence of smokers was 29% in 2000, compared with 31% in 1989, and prevalence of regular alcohol consumers (on monthly, weekly, or daily basis) was 50% vs 52% in 1989. Experience with all types of substances was more present among senior students, and less among medical students than their "non-medical" peers. Regular alcohol use was associated with the experience of illicit drugs use. In 2000, 40% of medical students and 53% of "non-medical" students voted for legalization of marijuana.

Conclusions. Experience with psychoactive substances is common among Zagreb medical students. Experiences with illicit drugs and psychoactive medications have substantially increased over the past decade.

Key words: *alcohol drinking; marijuana smoking; psychotropic drugs; smoking; students; students, medical*

The "presence" of various addictive substances in a society or population is another term for the availability of substances of addiction, spread of contact with such substances, or habits related to their use. Broader exposure of population to these substances provides larger basis for recruitment of individuals into groups with addiction problem (1). With respect to substance abuse, medical students are a specific population: during their education, they are trained to be able to deal with the problem in their patients. Their habits and attitudes towards substance abuse would, therefore, be of great importance.

Two cross-sectional surveys conducted among medical students at the Zagreb University in 2000 and 1989 aimed to reveal contacts and experience of students with different psychoactive substances and their habits related to substance use. The 2000 survey also included a small reference group of "non-medical" students. The 1989 survey inquired about the use of psychoactive medications in more detail. In addition to the description of the current status, these two surveys allowed an estimation of changes in some aspects of substance use, which occurred during the past decade among medical students at the Zagreb University.

Participants and Methods

Two cross-sectional surveys using an anonymous self-reporting questionnaires were conducted in 2000 and 1989 among students at the Zagreb University School of Medicine.

Surveys and Participants

Participation in the surveys was voluntary. The surveys were conducted over a 3-month-period during 1989/90 (most data collected during the last quarter of 1989) and 1999/2000 academic years (most data collected during the first quarter of 2000). The questionnaires were distributed and completed during lectures or seminars. We used a systematic random sampling procedure adjusted to the organization of the curriculum at the Zagreb University School of Medicine. We selected a course from each of the first three years of studies and surveyed all students attending the mandatory lectures of that course over one week. Students of the senior years were surveyed during a single lecture in the initial week of 3 major courses selected for the survey (highest attendance rate). Using this method, we expected to survey at least 1/3 of all students enrolled at the School of Medicine with a minimum bias. In both surveys, less than 2% of students refused to participate. In 2000, we surveyed 775 students (290 or 37% were men), and in 1989 we surveyed 986 students (387 or 39% were men). According to the official School registry, these numbers represented 44% and 50% of all students enrolled

at the School of Medicine in the year 2000 and 1989, respectively. Prevalence of women in the two surveys corresponded with the sex distribution at the School of Medicine. Therefore, we considered that sampling met the expectations. The 2000 survey additionally included 136 (32% men) "non-medical" students at the 3rd year of studies at the Liberal Arts College (psychology 26% and philosophy 48%) and Zagreb University School of Mechanical Engineering and Naval Architecture (mechanical engineering 26%). This student group was expected to be comparable with 3rd-year medical students (n=191, 35% of men) by size and sex distribution. The sampling procedure was the same as for the senior medical students.

All surveys were approved by the deans of the schools included in the survey.

Questionnaires

We collected general data about the students (school, sex, and study year) and data on the lifetime prevalence of contact with and/or habits related to various psychoactive substances (tobacco, alcohol, psychoactive medications, and illicit drugs). Most questions were multi-choice questions. A list of trade names of psychoactive medications were provided with questions related to their use. The lists were based on the editions of Croatian registry of approved drugs at the time and were amended by trade names found in the previous editions. The 1989 survey was more focused on the use and abuse of psychoactive medications. The 1989 questionnaire was very similar to that used in 2000 survey, except that a) there were more questions related to medication use; b) it did not record the frequency of alcoholic intoxications; c) it recorded only lifetime prevalence of contact with illicit drugs; and d) it did not inquire about attitudes towards the legalization of marijuana. The changes introduced in the 2000 questionnaire were based on the findings of our pilot survey carried out in the 1996-1998 period (2).

Checking questionnaires for validity. If data on the school (for "non-medical" students), sex, and study year were given, a questionnaire was considered generally valid. There were 775 valid questionnaires of medical students, 136 of "non-medical" students in 2000, and 986 questionnaires from 1989. The validity of each question was further checked. Participants were instructed to choose only a single answer to each question (except for listings of used substances) and, preferably, not to leave any questions unanswered. If unable to find "the exact answer" among the offered ones, they were instructed to choose the one that would be the closest to their preferred answer. Therefore, when none or more than one of the offered answers were given (except for listings of used substances), the question was treated as "unanswered".

Statistics

Data were presented as percentages with 95% confidence interval (CI); differences were also given as percentages with CI. All comparisons were carried out between un-paired samples. Frequency distributions of two samples across more than 2 categories were compared in n m contingency tables by determination of maximum likelihood chi-square. The significance level of a difference between two proportions was determined by a two-sided test where p-value was computed based on the t-value for the respective comparison. If more than one comparison of two proportions between samples was done, where proportions within a sample were not independent, p-value was corrected for the number of comparisons conducted (Bonferroni correction). A difference was considered truly significant if the corrected p-value was <0.05. If the p-value was 0.05-0.1 after correction, a difference was still reported as significant if a) the 95% CI of the difference did not include 0, and b) there was an overall significant difference between the samples (as estimated in n m tables).

Initial descriptive tabulation and cross-tabulation of the data indicated that some of the outcome variables illustrating experience, habits, and attitudes related to psychoactive substances were influenced by several independent variables. Maximum likelihood fit of a binary logistic regression model was used to test the influence of each of the independents, while controlling for the effects of the remaining ones. For this purpose, all outcome variables were re-coded as binary (yes/no). In line with the instructions about questionnaire completion given to participants, this included re-coding of missing answers as "no". For example, for the variable "regular daily alcohol consumption", the "yes" outcome included students who reported regular daily drinking, while the "no" outcome included all other alcohol consumers + non-consumers + those who did not answer the question about the amount of consumed alcohol (0.5%). The independent variables included in the models were the following: 1) "sex" (dichotomous male/female, no missing data); 2) "study year" (categorical, 5 categories, with no missing data); 3) "school" (dichotomous, medical/non-medical, with no missing data); 4) "have at least tried illicit drugs" (dichotomous, yes/no – the questionnaires positively identified both outcomes, but 1.4% of the students did not answer the question, so omitted answers were recoded as "no"); 5) "regular alcohol consumption" (dichotomous, yes/no – the questionnaires positively identified both outcomes, but 0.5% students did not answer the question – missing answers were recoded as "no").

The maximum number of independent variables per model was 3. Overall model performance was tested by determination of percentage of correctly classified cases and the model chi-square. If required, the model was adjusted by elimination of irrelevant variable(s).

Results

Cigarette Smoking

The prevalence of smokers among medical students in 2000 was 29%, compared with 31% in 1989. The prevalence of heavy smokers (>20 cigarettes a day) was 1.5%, which was significantly lower than in 1989 (6.8%). Other categories of cigarette smoking in the two surveys were comparable (Fig. 1). In 2000, there was no significant difference between men and women or between medical students and their "non-medical" peers (prevalence/category, from –1.5% to 1.7% and from –1% to 2.2%, respectively).

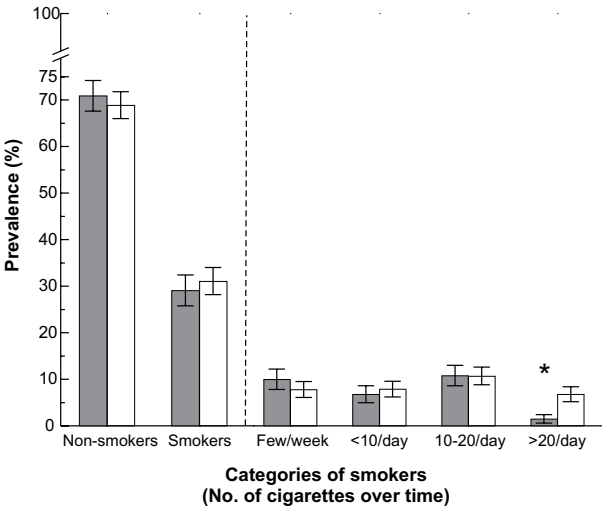

Figure 1. Prevalence (%) of smokers among medical students at Zagreb University in 2000 (n=775, 37% men) (closed bars) and 1989 (n=986, 39% men) (open bars). Vertical bars represent 95% confidence interval (CI). Each student was assigned into one of the categories of cigarette smoking. Distribution of students across the categories (non-smokers and 4 "classes" of smokers) differed between the 2000 and the 1989 surveys (maximum likelihood chi-square, 34.9, $p<0.001$). Asterisk indicates lower prevalence in 2000 vs 1989 (prevalence [95% CI], -5.3% [-7.1--3.5], $p<0.001$, with Bonferroni correction for 5 tests).

Table 1. Alcohol consumption among Zagreb University medical students in 2000*

Frequency and amount of consumed alcoholic drinks	Prevalence of drinking (%, 95% confidence interval)			
	total (n = 775)	men† (n = 290)	women (n = 485)	difference men - women (95% confidence interval)
At least 1 per day	3.4 (2.1-4.7)	5.9 (3.2-8.8)	2.3 (0.9-3.7)	3.6‡ (0.5-6.6)
At least 3-4 per week	9.5 (7.4-11.6)	18.0 (13.5-22.5)	5.0 (3.0-7.0)	13.0§ (8.0-18.0)
At least 3-4 per month	37.2 (33.7-40.7)	39.1 (33.4-44.8)	36.1 (31.7-40.5)	3.0 (-4.1-9.9)
A few or less per year	32.8 (29.6-36.0)	24.9 (19.9-29.9)	37.5 (33.1-41.9)	-12.6‖ (-19.0- -6.2)
Never	16.6 (13.9-19.3)	10.3 (6.7-13.9)	19.2 (15.6-22.8)	-8.9¶ (-13.9- -4.9)

*Students were categorized according to the reported frequency and amount of consumed alcoholic beverages.
†Distribution across the categories differed between men and women (Maximum Likelihood chi-square = 61.0, p < 0.001). Four participants, all men, did not answer the question about frequency and amount of consumption of alcoholic beverages.
‡p = 0.009; with Bonferroni correction for 6 tests p = 0.054.
§p < 0.001 with Bonferroni correction for 6 tests.
‖p < 0.001; with Bonferroni correction for 6 tests p = 0.002.
¶p = 0.001; with Bonferonni correction for 6 tests p = 0.006.

Table 2. Alcoholic intoxications among medical students at the Zagreb University in 2000. Students were assigned into one of the categories depending on the reported frequency of alcoholic intoxication

Frequency	Prevalence of alcoholic intoxication (%, 95% confidence interval)			Difference men - women (95% confidence interval)
	total (n = 775)	men* (n = 290)	women (n = 485)	
At least once a week	2.8 (1.6-4.0)	6.6 (3.7-9.5)	0.6 (-0.1-1.3)	6.0† (3.1-8.9)
At least once a month	15.2 (12.7-17.7)	24.6 (19.6-29.6)	9.7 (7.1-12.3)	14.9† (9.3-20.5)
Sporadically	38.6 (35.2-42.0)	41.2 (35.5-46.9)	37.1 (32.8-41.4)	4.1 (-3.2-11.0)
Once in a lifetime	10.3 (8.2-12.4)	8.3 (5.1-11.5)	11.5 (8.7-14.3)	-3.2 (-7.5-0.1)
Never	29.7 (26.5-32.9)	15.9 (11.7-20.1)	37.7 (33.4-42.0)	-21.8 (-27.8- -15.8)†
No answer‡	3.4	3.4	3.4	0

*Distribution across the categories of alcoholic intoxication differed between men and women (maximum likelihood chi-square = 81.5, p < 0.001).
†p < 0.001 with Bonferroni correction for 6 tests.
‡26 participants, 10 men and 16 women, did not answer the question about frequency of alcoholic intoxication.

Alcohol Consumption

About half of the medical students in the 2000 survey reported regular alcohol consumption on monthly (37%), weekly (9.5%), or daily (3.4%) basis (Table 1). Furthermore, 15% reported regular monthly, and 2.8% regular weekly intoxications (Table 2). The prevalence of students reporting regular drinking or regular intoxications was significantly higher in men than in women. There was no significant difference in alcohol consumption between the 2000 and the 1989 surveys (52% regular alcohol consumers). The frequency of alcoholic intoxications was not recorded in 1989. The prevalence of 3rd year medical students reporting regular monthly intoxications was significantly lower than in their "non-medical" peers (Fig. 2).

Psychoactive Medicaments

The lifetime prevalence of contact with psychoactive medications among medical students in 2000 was 33%, which was significantly higher than in 1989 (15%). The most frequently reported medications used at least once in the lifetime were benzodiazepines (Fig. 3). There was no significant difference between men and women in the 2000 survey: prevalence = –2.3% (from -9.1 to 4.5). Anxiety, psychological tension, insomnia, stress, overwork, depression, and similar psychological disturbances were most frequently listed reasons for consumption of psychoactive medications. However, 3.5% (95% CI, 2.2-4.8) of students explicitly listed non-medical reasons for consumption, such as fun, curiosity, experimentation, or relaxation. They were more prevalent among men than among women (5.2% [95% CI, 2.7-7.7] vs 2.4% [95% CI, 1.0-3.8], respectively; difference 2.7% [95% CI, -0.2-5.6]).

The lifetime prevalence of contact with psychoactive medications was comparable between 3rd year medical students and their "non-medical" counterparts. However, prevalence of those declaring the use of the drugs for non-medical reasons was significantly lower among medical students (1.6% [95% CI, -0.2-3.4] vs 6.6% [95% CI, 2.4-10.8], difference -5.0% [95% CI, -9.5- -0.5], p = 0.018).

Out of 258 students in 2000 and 190 students in 1989 who confirmed having experience with these drugs, only 33% (95% CI, 27.1-38.6) and 25% (95% CI, 18.9-31.1), respectively, described their predominant practice as "strict compliance with doctor's advice" regarding indication, dose, and duration of use of these drugs, and only 42% (95% CI, 36.4-47.6) and 36% (95% CI, 29.0-43.0), respectively, described their predominant practice as "obtaining the medications on prescription".

Illicit Substances

The lifetime prevalence of contact with illicit drugs among medical students in 2000 was 35%, which was significantly higher than in 1989 (14%). The most frequently reported substance used at least once in the lifetime was marijuana (Fig. 4). The lifetime prevalence of contact with illicit drugs in 2000 was significantly higher among men than among women (44.8% [95% CI, 39.1-50.5] vs 29.7% [95% CI, 25.6-33.8], respectively; difference 15.1% [95% CI, 8.1-22.1], p < 0.001). This difference was related to the increased use of marijuana, whereas other substances were reported with comparably low frequency. The mean age of the first contact with illicit

drugs was 17.5 years, with 50% of the students reporting their first contact with drugs between 16 and 19 years of age (Fig. 5). Overall, 3.6% (95% CI, 2.3-4.9) of medical students reported experience with 2 or more different substances and 3.9% (95% CI, 2.5-5.3) reported consumption of an illicit drug within a month before the survey (repeated use).

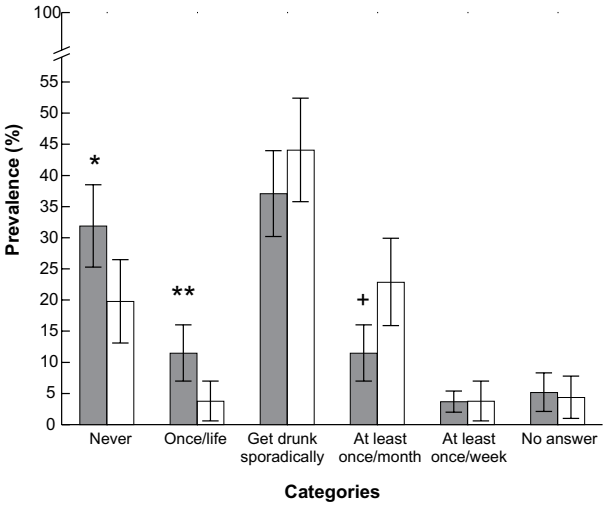

Figure 2. Frequency of alcoholic intoxications in 3rd year medical students (n = 191, 35% men) (closed bars) and their "non-medical" peers (n = 136, 32% men) (open bars) at Zagreb University in 2000. Each student was assigned into one of the categories depending on the reported frequency of alcoholic intoxications. Prevalence (%) per category is shown (vertical bars, 95% confidence interval [CI]). Overall, 10 medical and 6 "non-medical" students did not answer the question. Distribution of students across the categories (5 categories + those who did not answer) differed between medical and "non-medical" students (maximum likelihood chi-square, 17.6, p = 0.004). Asterisk indicates higher prevalence in medical vs "non-medical" students (prevalence, 7.7 [2.73-13.1], p = 0.009; with Bonferroni correction for 6 tests p = 0.054). Double asterisk indicates higher prevalence in medical vs "non-medical" students (prevalence, 12.1 [2.7-21.5], p = 0.01; with Bonferroni correction for 6 tests p = 0.06). Plus indicates lower prevalence in medical vs "non-medical" students (prevalence, -11.4% [-19.0- -3.0], p = 0.007; with Bonferroni correction for 6 tests p = 0.042).

The lifetime prevalence of contact with illicit drugs in the 3rd-year medical students was lower than in their "non-medical" peers (Table 3). Prevalence of those reporting repeated use was also lower (2.1% [95% CI, 0.1–4.1] vs 6.6% [95% CI, 2.4–10.8], respectively; difference -4.5% [95% CI, -9.1–0.1]).

Multiple Substance Use

The prevalence of medical students in the 2000 survey that reported regular daily smoking (from a

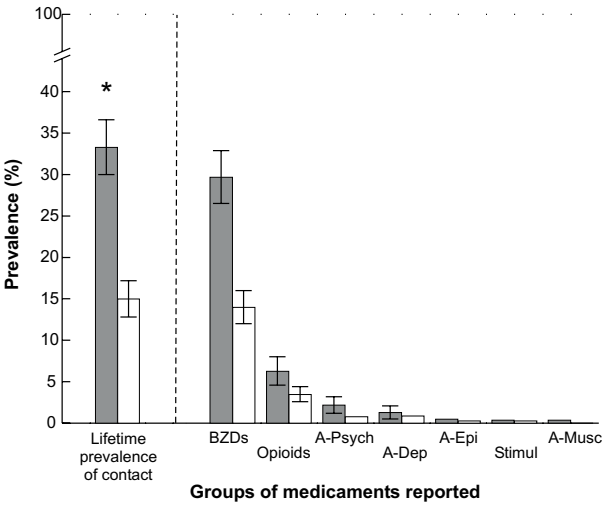

Figure 3. Lifetime prevalence of contact with psychoactive medications (left) and prevalence of medical students at Zagreb University reporting experience with different groups of medications (right) in 2000 (n = 775, 37% men) (closed bars) and 1989 (n = 986, 39% men) (open bars). Vertical bars represent 95% confidence interval (CI). Abbreviations: BZDs – benzodiazepines; opioids – refers to opioid antitussive and analgesic agents; A-psych – antipsychotics (neuroleptics); A-dep – antidepressants; A-epi – antiepileptics; stimul – psychostimulants; A-musc – antimuscarinics with central action. Each student was asked to mark on the supplemented list all medications that he/she had used at least once. Lifetime prevalence of contact = number of students that have marked at least one medicament / total number of students x 100. Prevalence of students reporting experience with a particular medicament (number of students marking the medicament / total number of students x 100). Asterisk indicates higher prevalence in 2000 vs 1989 (prevalence [95% CI], 18.3% [14.3-22.3], p < 0.001).

Table 3. Experience with illicit drugs in medical (3rd year) and non-medical students in 2000*

Experience	Prevalence (%, 95% confidence interval) medical students (n = 191; 35% men)	"non-medical" students (n = 136; 32% men)	difference (95% confidence interval) medical - "non-medical"
Lifetime contact with illicit drugs:			
total	34.6 (27.9-41.3)	44.9 (36.6-53.2)	-10.3 (-21.0-0.4)
men	38.8 (26.9-40.4)	43.2 (28.2-58.2)	-4.4 (-23.5-14.7)
women	32.3 (24.1-40.4)	45.7 (35.3-56.1)	-13.4 (-26.5- -0.3)
In those reporting experience with:			
marijuana	31.9 (25.3-38.5)	41.2 (32.9-49.5)	-9.3 (-19.8-0.2)
ecstasy	2.1 (0.1-4.1)	7.4 (3.0-11.8)	-5.3 (-10.1- -0.5)
hallucinogens	2.1 (0.1-4.1)	5.9 (2.0-9.8)	-3.8 (-8.2-0.6)
amphetamines	1.0	1.5	-0.5
opiates	0.5	0.7	-0.2
cocaine (or crack)	1.0	2.2	-1.2
inhalants	1.0	0.7	0.3

*Each student was asked to list all substances that he/she had used at least once. Lifetime prevalence of contact – number of students that have listed at least one substance / total number of students x 100. Prevalence of students reporting experience with a particular substance – number of students listing the substance / total number of students x 100.

few to >20 cigarettes a day), regular alcohol consumption (at least 3-4 drinks a month or more frequently), and having at least one experience with an illicit drug in their lifetime was 10.3% (95% CI, 8.4-12.4). There was no significant difference between men and women, or between the 3rd-year medical students and their "non-medical" peers. The prevalence of medical students reporting at least one experience of a simultaneous consumption of alcohol and illicit drugs and/or psychoactive medications was 6% (significantly higher in men than in women) (Table 4), and lower among the 3rd-year medical students than among their "non-medical" peers (5.1% [95% CI, 2.0-8.2] vs 10.3% [95% CI, 5.2-15.4], respectively; difference -5.1 [95% CI, -11.1-1.0]).

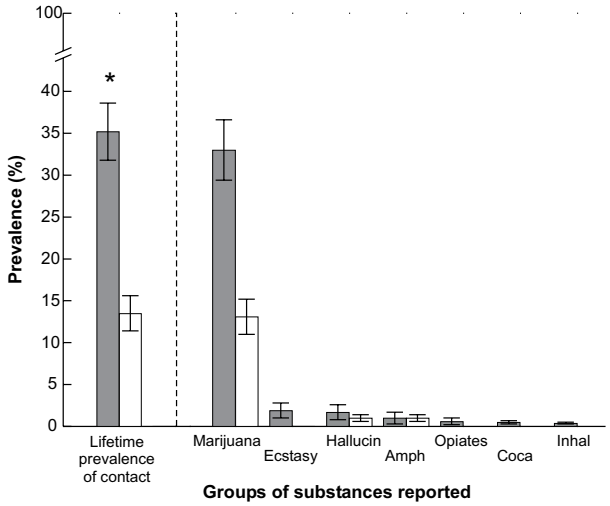

Figure 4. Lifetime prevalence of contact with illicit drugs (left) and prevalence of medical students at Zagreb University reporting experience with different groups of substances (right) in the years 2000 (n = 775, 37% men) (closed bars) and 1989 (n = 986, 39% men) (open bars). Vertical bars represent 95% confidence interval (CI). Abbreviations: hallucin – hallucinogens (LSD, mescaline, psylocibin, PCP, ketamine, hallucinogenic mushrooms, "trip"); amph – amphetamines (amphetamine, metamphetamine, ephedrine, "speed"); opiates – heroine, morphine, methadone; coca –cocaine (or "crack"); inhal – inhalants. Each student was asked to list all substances that he/she had used at least once. Lifetime prevalence of contact – number of students that have listed at least one substance / total number of students x 100. Prevalence of students reporting experience with a particular substance – number of students listing the substance / total number of students x 100. Asterisk indicates higher prevalence in 2000 vs 1989 (prevalence [CI], 21.7% [17.7-25.7], p < 0.001).

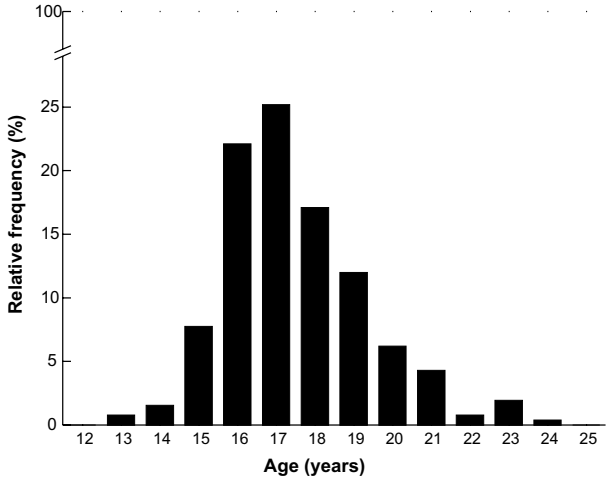

Figure 5. Age (years) of medical students at Zagreb University when they had a first contact with illicit drugs reported in the 2000 survey. There were 258 students (15/273 in contact, or 5.5%, did not report the age of first contact). Mean (95% confidence interval), 17.5 (17.3-17.7); median (range), 17 (13–24); 1st-3rd quartile, 16–19.

Study Year and Experience with Psychoactive Medications

The overall prevalence of smokers, "heavy smokers", and regular "daily drinkers", lifetime prevalence of contact with psychoactive medications and illicit drugs, and prevalence of "regular smokers and drinkers" who had had at least one contact with illicit drugs were all generally higher among medical students in later years than among those in early years of their studies. Binary logistic regression analysis with adjustment for sex suggested influence of the "study year" factor on each of these parameters (Table 5).

Alcohol Consumption and Experience with Illicit Drugs

The prevalence of students that had had at least one experience with illicit drug(s) in the lifetime (lifetime prevalence of contact), prevalence of those that had used illicit drug(s) within a month before the survey (repeated use), and prevalence of those that had had at least once consumed alcohol and drugs simultaneously were all significantly higher in "regular alcohol consumers" than in the rest of the surveyed medical students (Table 6). Logistic regression analysis in which the influence of each of three "independent factors" (study year, sex, and regular alcohol consumption) was investigated, with the adjustments for the remaining two, revealed that regular alcohol consumption had by far the strongest influence on parameters illustrating experience with illicit drugs. Regular alcohol consumers were 3.9 times more likely than other students to have used an illicit drug at least once in their lifetime, 3.8 times more likely to have at least once consumed alcohol and drugs simultaneously, and 4.5 times more likely to have used illicit drug within a month before the survey (repeated use) (Table 6).

Attitudes towards Legalization of Marijuana

Overall, the prevalence of votes for the legalization of marijuana among 775 medical students in the 2000 survey was 43% (95% CI, 39.5-46.6). It was higher in men than in women, and higher in those that had at least once tried an illicit drug. The prevalence of those who voted for legalization varied depending on the year of study, and was highest in senior students (59%) (Table 7). Logistic regression analysis in which the influence of each of three "independent factors" (study year, sex, and experience with illicit drug) was investigated, with adjustments

for the remaining two, revealed that sex influenced the prevalence of votes for legalization with a borderline significance (p = 0.079). The influence of study year (p = 0.006) was significant, whereas previous experience with illicit drugs showed the strongest influence (p < 0.001): students who reported having used an illicit drug at least once in their life were 3 times more likely to vote for legalization of marijuana than the others (Table 8).

Prevalence of votes for legalization was lower among the 3rd-year medical students than among their "non-medical" peers (40.3% [95% CI, 33.3-47.3] vs 53.0% [95% CI, 44.6-61.4], respectively; difference −12.7% [95% CI, -23.6- -1.8], p = 0.023). Binary logistic regression analysis (not shown), with adjustment for two factors, experience with illicit drugs and sex, suggested that the factor "school (non-medical)" influenced the prevalence of votes for legalization

Table 4. Simultaneous use of psychoactive substances among Zagreb University medical students in 2000*

Answers	Prevalence of psychoactive substances use (%) (95% confidence interval) total (n = 775)	men† (n = 290)	women (n = 485)	Difference men – women (95% confidence interval)
Never	80.0 (77.2-82.8)	75.0 (70.0-80.0)	82.5 (79.1-85.9)	-7.25‡ (-13.3 to -1.25)
At least once	6.0 (4.3-7.7)	10.3 (6.8-13.8)	3.7 (2.0-5.4)	6.6§ (2.7-10.5)
No answer‖	14.0	14.7	13.8	0.9

*Participants were asked to state whether they had ever consumed any of the following combinations of substances: alcohol + illicit drug(s), alcohol + psychoactive medicament(s), alcohol + illicit drug(s) + psychoactive medicament(s).
†Distribution of answers differed between men and women (maximum likelihood chi-square = 13.9, p < 0.001).
‡p = 0.012; with Bonferroni correction for 3 tests p = 0.036.
§p < 0.001 with Bonferroni correction for 3 tests.
‖109 students (43 men and 66 women) did not answer the question about simultaneous substance use.

Table 5. Influence of study year on experience with psychoactive substances in 775 medical students (2000 survey)

Parameters (outcome variables)	Prevalence per study year (%) (95% confidence interval) 1st	2nd	3rd	4th	5th + 6th	Binary logistic regression analysis ("study year" adjusted for sex*) coefficient (SE)	ratio	p
No. of students	127	222	191	93	142			
All smokers	24.4 (17.0-31.8)	28.0 (22.1-33.9)	38.7 (32.0-45.4)	36.6 (26.9-46.3)	37.2 (29.3-45.1)	-0.139 (0.057)	-2.44	0.027†
Heavy smokers‡	0.2	0.9	1.6	1.1	4.9 (1.3-8.5)	-0.667 (0.235)	-2.84	0.011§
Regular daily drinkers‖	0.8	2.7 (0.6-4.8)	3.1 (0.6-5.6)	3.2 (0-6.4)	7.0 (2.8-11.2)	-0.411 (0.153)	-2.68	0.016¶
Lifetime prevalence of contact with psychoactive medications	20.5 (13.4-27.5)	28.4 (22.5-34.3)	30.4 (23.9-36.9)	46.5 (36.6-56.7)	50.0 (41.8-58.2)	-0.313 (0.059)	-5.35	< 0.001**
Lifetime prevalence of contact with illicit drugs	30.7 (22.7-38.7)	28.4 (22.5-34.4)	34.6 (27.9-41.3)	51.6 (41.6-61.6)	40.1 (32.1-48.1)	-0.183 (0.05 8)	-3.14	0.006††
Smoking and drinking regularly‡‡ + experience with illicit drugs	8.7 (3.8-13.6)	5.9 (2.8-9.0)	13.6 (8.7-18.5)	13.0 (6.2-19.8)	15.5 (9.5-21.5)	-0.181 (0.088)	-2.06	0.051§§

*All dependent variables were binary (yes/no), and independent variables were always "sex" and "study year".
†Model classified 68% cases correctly. Model chi-square was 5.9, df = 2, p = 0.052. When "sex" was not included (as apparently irrelevant variable), model fit was improved (chi-square = 5.84, df = 1, p = 0.016).
‡Smoke > 20 cigarettes a day.
§Model classified 98% cases correctly; model chi-square = 9.64, df = 2, p = 0.008.
‖At least one drink a day.
¶Model classified 96% cases correctly; model chi-square = 12.1, df = 2, p = 0.002.
**Model classified 67% cases correctly; model chi-square = 29.8, df = 2, p < 0.001.
††Model classified 66% cases correctly, model chi-square = 27.9, df = 2, p < 0.001.
‡‡Smoke daily and have at least 3-4 drinks a month or more frequently.
§§Model classified 88% cases correctly, model chi-square = 7.2, df = 2, p = 0.027.

Table 6. Relationship between regular alcohol use and experience with illicit drugs in 775 medical students (2000 survey)

Parameters of experience with illicit drugs (outcome variables)	Prevalence (% with 95% confidence interval) regular alcohol consumers† (n = 388)	others (n = 387)	difference consumers – others (95% confidence interval)	Binary logistic regression analysis* factor	coefficient (SE)	ratio (p)	odds ratio (95% confidence interval)‡
At least one use of an illicit drug in the lifetime (Lifetime prevalence of contact)	50.5 (41.9-59.1)	19.9 (15.9-24.9)	30.6 (21.1-40.1)§	study year	-0.198 (0.060)	-3.292 (0.002)	
				sex (men)	0.466 (0.192)	2.419 (0.021)	1.59 (1.09-2.32)
				alcohol (regular)	1.367 (0.167)	8.197 (<0.001)	3.92 (2.83-5.44)
Illicit drug use within previous month (repeated use)	6.4 (4.0-8.8)	1.3 (0.2-2.4)	4.1 (1.4-6.8)§	study year	0.078 (0.141)	0.555 (0.582)	
				sex (men)	0.856 (0.448)	1.911 (0.064)	2.35 (0.98-5.66)
				alcohol (regular)	1.505 (0.499)	3.013 (0.004)	4.5 (1.69-11.98)
Alcohol + drugs at least once in the lifetime	9.8 (6.8-12.8)	2.3 (0.8-3.8)	7.5 (4.2-10.8)§	study year	-0.204 (0.114)	-1.794 (0.081)	
				sex (men)	0.936 (0.410)	2.282 (0.028)	2.55 (1.14-5.70)
				alcohol (regular)	1.333 (0.382)	3.481 (0.001)	3.79 (1.79-8.01)

*All outcome variables were binary (yes/no), and independent variables were "study year", "sex" and "regular alcohol consumption". First model (outcome "lifetime prevalence of contact") classified 72% cases correctly; model chi-square = 32.1, df = 3, p < 0.00. Second model (outcome "repeated use") classified 94% cases correctly; model chi square = 31, df = 3, p < 0.001; third model (outcome "simultaneous use") classified 93% cases correctly, model chi-square = 29.8, df = 3, p < 0.001.
†Have at least 3-4 alcoholic drinks a month or more frequently.
‡Only for 2 × 2 data: sex (men/women) × yes/no; alcohol use (regular/sporadic) × yes/no.
§p < 0.001 with Bonferroni correction for 3 tests.

Table 7. Prevalence of votes for the legalization of marijuana among 775 Zagreb University medical students according to sex, experience with illicit drugs, and study year (year 2000)

Parameter	No. of students	Prevalence (%, 95% confidence interval)	Difference (95% confidence interval)
Sex:			
men	290	49.7 (44.0-55.4)	men – women
women	485	39.0 (34.7-43.3)	10.7 (3.5-17.9) p = 0.004
Illicit substances:			
at least "tried"	273	61.5 (55.7-67.3)	"tried" – others
others	502	32.9 (28.8-37.0)	28.6 (21.5-35.7) p < 0.001
Study year:			
1st	127	34.6 (26.3-42.9)	
2nd	222	41.4 (34.9-47.9)	
3rd	191	40.3 (33.3-47.3)	
4th	93	38.7 (28.8-48.6)	
5th + 6th	143	59.2 (51.2-67.2)	

Table 8. Influence of study year, sex and experience with illicit drugs on prevalence of votes for the legalization of marijuana in 775 medical students at the Zagreb University (year 2000) – maximum likelihood fit of the binary logistic regression model*

Factor	Coefficient (SE)	Ratio (p)	Odds ratio (95% confidence interval)†
Study year	-0.165 (0.058)	-2.865 (0.006)	
Sex (men)	0.306 (0.169)	1.810 (0.079)	1.36 (0.98-1.89)
Experience with illicit drugs‡	1.099 (0.159)	6.928 (<0.001)	3.00 (2.20-4.10)

*Outcome variable – "vote for legalization of marijuana" (yes/no); independent variables: "study year", "sex" and "experience with illicit drugs". The model classified 66% cases correctly (model chi-square, 70.4, df = 3, p < 0.001).
†Only for 2x2 data: sex (men/women) x yes/no and experience with illicit drugs (yes/no) x yes/no.
‡"Tried" an illicit drug at least once.

with borderline significance (odds ratio 1.52 [95% CI, 0.99-2.29], p = 0.067).

Discussion

According to the research in some Western countries (3,4), medical students, as well as other university students, tend to follow the increasing trend of psychoactive/addictive substance use and abuse, as encountered in the general younger population. Such pursuits among medical students are of special concern, considering their future profession.

The prevalence of smoking among medical students at the Zagreb University in the 2000 survey was not excessively high (29% or 19%, considering only "daily smokers"). Since the anti-smoking campaign has been ever stronger over the past 10 years, the finding that prevalence of smoking did not change much between 1989 and 2000 (although the proportion of "heavy smokers" decreased) is somewhat unexpected. Also, the prevalence of smokers and heavy smokers increased with the year of studies. This appears to be a general trend among medical students worldwide (1,5-7). Richmond and Kehoe (7) showed that the prevalence of smoking increased with years of study, although the students' awareness about harmful effects of smoking also increased.

The main concern regarding alcohol consumption are medical students who get drunk regularly on monthly or weekly basis, or those who drink daily or regularly during the week. In general, however, our findings suggest that alcohol consumption among Zagreb medical students might be less worrying than among their colleagues in some Western countries (8). The UK Royal College of Physicians classifies adolescents in regard to alcohol consumption as "non-drinkers" and "drinkers", with the latter further classified as those practicing low-risk drinking (1-21 units of alcohol per week for men, and 1-14 units per week for women), medium-high risk drinking (22-50 units per week for, men and 15-35 units per week for women), or hazardous drinking (> 50 units per week for men and > 35 units per week for women) (8). One unit of alcohol is defined as 0.25 l of beer, 1 glass of wine, or 1 measure of spirit (25-30 mL). In a recent report on a sample of British medical students, only 3.6% of Caucasian students were "non-drinkers", 50% were "low-risk drinkers", 30% were "medium-high-risk drinkers" and, 16% were "hazardous drinkers" (9). Similarly, a high rate of "hazardous drinkers" was recently reported among Swedish medical students (10). We observed a relatively high proportion of "non-drinkers" (17%) in our study. Further, the great majority of "alcohol consumers" in our 2000 survey would basically be at the lower limit (or even below) of the definition of "low-risk drinking" (cumulatively, 70% declared having 3-4 drinks a month or less), and additional 10% could be characterized as real "low-risk drinkers", or possibly as "borderline low-medium risk drinkers" (having at least one drink 3-4 times a week). Not more than 3-4% could be tentatively considered as those having medium-high-to-hazardous drinking habits (having at least one drink a day or getting drunk at least once a week). The observation that alcohol consumption apparently increased during studies seems to illustrate a general trend among medical students since similar results were reported in other surveys (11-14).

Although lifetime prevalence of contact with psychoactive medications (benzodiazepines) reported in the 2000 survey (33%) was more than two-fold higher than in 1989 (15%), it might not be of particular importance. But observed potential misuse could raise some concern. First, 3.5% of participants in 2000 explicitly listed "curiosity", "relaxation", "fun", and/or "experimentation" as major reasons for using these drugs. In the context of substance abuse, they could belong to the same group with students reporting the use of illicit drugs (11). Second, it appears that the medications were largely used without medical supervision. In both surveys, only 20-40% of students who had at least once consumed these drugs described their "common practice" as "strict compliance with doctor's advice", implying some form of self-medication in the majority of cases. Higher lifetime prevalence of contact with psychoactive medications observed among students at higher study years suggests that use of these drugs most likely increases with the years of study (Table 5). This was also reported for medical students in other surveys (11,15).

Our findings related to experience of the Zagreb University medical students with the use of illicit

drugs support several conclusions. Considering the lifetime prevalence of contact with drugs reported in the year 2000 (35% of students using almost exclusively marijuana) and the prevalence of "repeated users" (3.9%) and those with the experience of simultaneous use of drugs and alcohol (6.0%), one could say that the experience with illicit drugs in this sample of students was generally restricted to marijuana. This might be considered far less worrying than what was reported for medical students in US or UK during the mid- or late 1990's, with >65% lifetime prevalence of contact with marijuana, 5-30% of "current marijuana users" (on weekly or monthly basis, or "frequently"), 5-10% of regular "recreational" ecstasy users, a similar percentage of "recreational" users of amphetamines and/or hallucinogens, around 5% of occasional cocaine users, and up to 10% lifetime prevalence of contact with opiates (1,9,11,16,17). However, concern arises from an increasing trend of drug use, illustrated by a 2-fold increase in lifetime prevalence of contact with illicit drugs between 1989 (14%) and 2000 (35%), whereas illicit drugs use among medical students and other university students in Western countries seems to have been decreasing during the 1990's (18,19).

Croen et al (20) suggested that medical students generally "gather" their experience with illicit drugs during the young adolescent age, ie, before entering the university, and that later on they do not "expand" but rather abandon the use of these substances. Our findings were generally in line with these observations (mostly one-time contact with marijuana and most frequently by the age of 19). Still, there were around 4% of "active users" in the surveyed population. In addition, the facts that lifetime prevalence of contact was higher among senior than among younger students and that age when the first contact with these substances occurred was up to 24 years suggest that the first contact with illicit drugs in the surveyed population happened rather frequently in individuals already studying medicine.

Regular alcohol use was associated with more extensive experience with illicit drug use among medical students in the 2000 survey. Furthermore, the experience with illicit drugs was associated with higher rate of votes for the legalization of marijuana, which could be perceived as a surrogate marker of a "benevolent attitude" towards illicit drugs use. These findings are in line with the findings among medical and other university students and adolescents from other countries, and support the theory that alcohol is a "gateway" to illicit drugs (9,11,21,22). In practical terms, these observations suggest that the primary illicit drugs use prevention programs need to cover all other psychoactive/addictive substances.

Qualitatively, "non-medical" students in the 2000 survey did not differ from medical students with respect to substance use and abuse – the patterns observed in these two groups were practically identical. Quantitatively, however, there were apparent differences, suggesting more pronounced use of psychoactive/addictive substances in "non-medical" students: 19% more "non-medical" students reported monthly alcoholic intoxications ($p=0.007$), which is most likely a truly significant difference (sample sizes of 136 non-medical and 191 3rd-year medical students achieved 47% power to detect a difference between 23% and 12% as significant at this level). Up to 9.5% more "non-medical" than medical students reported non-medical use of psychoactive medications ($p=0.018$), where the significance might be suspicious (the study had 39% power to detect a difference between 6.6% and 1.6% as significant at this level). The lifetime prevalence of contact with illicit drugs was 10% higher in "non-medical" students, which was not significant, but the study had only 43% power to detect a difference between 35% and 45% as significant at the 0.05 level. There were 5% more "non-medical" than medical students who reported to have simultaneously used alcohol and drugs at least once in their life and 5% more who reported repeated use of illicit drugs; none of the differences was significant. However, the study had only 50% and 34% power to detect differences between 7% and 2% and 10% and 5%, respectively, at the 0.05 level of significance. Although we found statistically significant differences between medical students and their "non-medical" peers, we must point out the limitations of our statistical analysis. First, some differences could be falsly significant due to the number of tests we performed. Second, the study was under-powered for most comparisons (only 193 medical and 136 "non-medical" students). Inspite of that, the general impression is that Zagreb University medical students are "one step behind" their "non-medical" peers in terms of "intensity" of substance use and abuse. Finally, there were 2-24% more "non-medical" than medical students who voted for legalization of marijuana. This was most likely related to their more "extensive" experience with illicit drugs. Still, even with the adjustment for this experience and sex, they were 1.5 times more likely than the medical students to give their vote for legalization.

In conclusion, results of our surveys suggest that use of socially accepted psychoactive substances (tobacco and alcohol) among medical students at Zagreb University has been kept at a stable and relatively low level over the past decade. At the same time, experience with illicit drugs and psychoactive medications have increased.

Acknowledgment

We thank Drs. Anna Mrzljak and Dražana Bjeloš, for their dedication in conducting the survey in the year 2000, at which time they were still undergraduate medical students. We also express our gratitude to the Deans of the School of Medicine, Liberal Arts College, and Faculty of Mechanical Engineering and Naval Architecture, with whose permission the surveys were conducted.

References

1 Ashton CH, Kamali F. Personality, lifestyles, alcohol and drug consumption in a sample of British medical students. Med Educ 1995;29:187-92.

2 Trkulja V, Lacković Z. Addictive substances and medical students in Zagreb. Liječ Vjesn 1999;121:115-7.

3 Webb E, Ashton C, Kelly P, Kamali F. Alcohol and drug use in UK university students. Lancet 1996;348:922-5.
4 Webb E, Ashton H, Kelly P, Kamali F. Patterns of alcohol consumption, smoking and illicit drug use in British university students: interfaculty comparisons. Drug Alcohol Depend 1997;47:145-53.
5 Yassine N, Bartal M, el Biaze M. Smoking among medical students in Casablanca [in French]. Rev Mal Respir 1999;16:59-64.
6 Xiang H, Wang Z, Stallones L, Yu S, Gimbel HW, Yang P. Cigarette smoking among medical college students in Wuhan, People's Republic of China. Prev Med 1999;29:210-5.
7 Richmond RL, Kehoe L. Smoking behaviors and attitudes among Australian medical students. Med Educ 1997;31:169-76.
8 Alcohol and the young. Summary of a report of a joint working party of the Royal College of Physicians and the British Paediatric Association. J R Coll Physicians Lond 1995;29:470-4.
9 Newbury-Birch D, White M, Kamali F. Factors influencing alcohol and illicit drug use amongst medical students. Drug Alcohol Depend 2000;59:125-30.
10 Borschos B, Kuhlhorn E, Rydberg U. Alcohol and drug use among medical students 1995: more than every tenth male student had hazardous alcohol drinking habits [in Swedish]. Lakartidningen 1999;96:3253-8.
11 Newbury-Birch D, Walshaw D, Kamali F. Drink and drugs: from medical students to doctors. Drug Alcohol Depend 2001;64:265-70.
12 Naskar NN, Bhattacharya SK. A study on drug abuse among the undergraduate medical students in Calcutta. J Indian Med Assoc 1999;97:20-1.
13 Laporte JR, Cami J, Gutierrez R, Laporte J. Caffeine, tobacco, alcohol and drug consumption among medical students in Barcelona. Eur J Clin Pharmacol 1977;11: 449-53.
14 Kory WP, Crandall LA. Nonmedical drug use patterns among medical students. Int J Addict 1984;19:871-84
15 Laure P. Consumption of performance-enhancing drugs by medical students in Nancy [in French]. Therapie 2000;55:383-9.
16 Ghodse AH, Howse K. Substance use of medical students: a nationwide survey. Health Trends 1994;26: 85-8.
17 Baldwin DC Jr, Hughes PH, Conard SE, Storr CL, Sheehan DV. Substance use among senior medical students. A survey of 23 medical schools. JAMA 1991; 265:2074-8.
18 Martinez JM, Del Rio MC, Lopez N, Alvarez FJ. Illegal drug-using trends among students in a Spanish university in the last decade (1984-1994). Subst Use Misuse 1999;34:1281-97.
19 Pope HGJr, Ionescu-Pioggia M, Pope KW. Drug use and life style among college undergraduates: a 30-year longitudinal study. Am J Psychiatry 2001;158:1519-21.
20 Croen LG, Woesner M, Herman M, Reichgott M. A longitudinal study of substance use and abuse in a single class of medical students. Acad Med 1997;72:376-81.
21 Johnson PB, Boles SM, Kleber HD. The relationship between adolescent smoking and drinking and likelihood estimates of illicit drug use. J Addict Dis 2000;19:75-81.
22 Best D, Rawaf S, Rowley J, Floyd K, Manning V, Strang J. Drinking and smoking as concurrent predictors of illicit drug use and positive drug attitudes in adolescents. Drug Alcohol Depend 2000;60:319-21.

Received: May 8, 2002
Accepted: December 11, 2002

Correspondence to:
Vladimir Trkulja
Department of Pharmacology
Zagreb University School of Medicine
Šalata 11
10000 Zagreb, Croatia
vladimir.trkulja@zg.hinet.hr