ONLINE FIRST

This is a provisional PDF only. Copyedited and fully formatted version will be made available soon.

Psychiatria

ISSN: 1732-9841

e-ISSN: 1733-4594

Use of psychoactive substances by Polish students during exam time

Authors: Justyna Gacek, Roksana Duszkiewicz, Rafał Bobiński

DOI: 10.5603/PSYCH.a2021.0031

Article type: Research paper

Submitted: 2020-08-05

Accepted: 2021-05-10

Published online: 2021-08-16

Justyna Gacek[1], Roksana Duszkiewicz[2], Rafał Bobiński[1]

[1]Department of Biochemistry and Molecular Biology, Faculty of Health Sciences, University of Technology and Humanities in Bielsko-Biała, Poland

[2]Faculty of Medical Sciences in Katowice, Medical University of Silesia, Katowice, Poland

Use of psychoactive substances by Polish students during exam time

Address for correspondence:
Justyna Gacek
Department of Biochemistry
and Molecular Biology, Faculty
of Health Sciences,
University of Technology
and Humanities in Bielsko-Biała
jgacek@ath.bielsko.pl

Abstract

Introduction: The objective of the study was to determine whether students take psychoactive substances during exam time and whether it affects their academic performance. The assessment was a subjective evaluation by the student. The purpose of the work was also to determine which psychoactive substances are the most popular among students, and whether students feel under pressure, in their environment, to produce the best results.

Material and methods: An anonymous online survey about the use of psychoactive substances was conducted between November 1, 2017 and March 31, 2018. It was addressed to students of Polish universities. In total 610 students took part in the survey. More than half of the respondents were men. After adjustments were made to the questionnaires where e.g. not all the questions were answered, 536 surveys remained.

Results: Students feel pressurised by their parents to obtain the best results and to take part in the so-called "rat race". The most popular psychoactive substance is marijuana. Students use psychoactive substances, but in a much smaller amount than expected by the authors.

Conclusions: The problem of psychoactive substance use is not as big as was assumed at the beginning of the study, however, in order to completely eliminate the problem of using psychoactive substances, lectures should be held on the consequences of drug use.

Key words: psychoactive substances, drugs, exam time

Introduction

In medicine, so-called psychoactive substances have an effect on the receptors in the central nervous system (CNS), e.g. an analgesic effect [1]. Each psychoactive substance affects the human body in a different way, some of them can even cause illusions or hallucinations [2]. The effect of taking these substances can also act on the autonomic nervous system, resulting in e.g. increased blood pressure, agitation or an increased heart rate [3]. Psychoactive substances can be of synthetic or natural origin. Their misuse can lead to addiction, often referred to as drug dependency or toxicomania [4]. The administration of psychoactive substances is accompanied by an increase in the production of dopamine in the mesolimbic system [5].

Prolonged elevation of dopamine concentration levels results in a rise in adenylate cyclase activity and an increase in the synthesis of cyclic adenosine monophosphate (cAMP) [6]. Raised cAMP levels escalate the synthesis of the unstable cAMP Response Element Binding (CREB) Protein. This is a transcription factor that mediates cAMP activity. The use of psychoactive substances causes phosphorylation and thus activation of CREB in the reward system structures [7]. Psychostimulants activate D1 dopaminergic receptors and induce CREB in the accumbens nucleus. The reduced sensitivity to the rewarding stimulus as a result of taking morphine or sucrose is associated with increased CREB activity in this brain structure [8].

In addition, within the accumbens nucleus, there is an increase in the expression of the gene encoding the endogenous opioid peptide — dynorphin, controlled by CREB. The activation of opioid receptors in the dopaminergic neurons of the ventral tegmental area (VTA) by the dynorphin slows down the release of dopamine and causes a temporary shutdown of the reward system [9]. Prolonged CREB activation in drug addicts forces an ever-increasing dosage in order to achieve the desired effect. The drug's rewarding and dysphoric effect (sensitivity, volatility) is associated with strong stimulation of κ receptors by the dynorphin which leads to a reduction in bursts of dopamine. The strong stimulation of κ receptors by dynorphin, which reduces dopamine burst, weakens the rewarding effects of drugs and causes dysphoria (sensitivity, volatility) [10]. As a result of the intensification of dopaminergic transmission. synthesis of the ΔFosB protein takes place. This protein, unlike CREB, is stable and breaks down only 6-8 weeks after cessation of drug-taking. The stability and durability of ΔFosB determines the phosphorylation of serine at position 27 (Ser27) [11]. ΔFosB slows down the synthesis of dynorphin and stimulates the expression of genes encoding drug-sensitising proteins. It is believed that ΔFosB activates genes that

encode the proteins which are responsible for controlling the production of glutamate - the most important stimulatory neurotransmitter. Neurons, particularly those found in the nucleus accumbens, are extremely sensitive to glutamate [12]. ΔFosB acts in the opposite way to CREB. The stimulation of CREB results in a state of reduced sensitivity to the rewarding stimulus and a decrease in emotional activity. In contrast, the increase in ΔFosB is associated with increased sensitivity to psychoactive substances and an increased tendency to respond to rewarding stimuli [13].

At first, after taking the drug, CREB activity is increased, which results in the need to take larger amounts in order to achieve the desired effect. The cessation of substance misuse causes a reduction in CREB concentration and a reduction in tolerance. At the same time, as a result of the increased synthesis of ΔFosB, the sensitivity of the nerve cells also increases, leading to a stronger drug craving and the compulsion to seek it out at all costs [14]. Aside from the dopaminergic processes, other neurotransmitter systems involved in the development of dependency include: the glutamatergic, endocannabinoid, opioid or γ-aminobutyric acid (GABA) systems [15] Some psychoactive substances (illicit drugs when inhaled, barbiturates, benzodiazepines) do not activate the dopaminergic system, yet they have strong rewarding properties [16].

Glutamate is the most important stimulatory neurotransmitter in mammals. Its effect relies on the regulation of specific glutamate receptors - the ionotropic and metabotropic receptors [17]. The first of these are ion channels that, in their active state, increase the flow of cations, mainly sodium, potassium and to a lesser extent calcium ions, through the membrane. It was later proved that glutamate stimulates the intracellular signalling cascade in a manner typical for receptors associated with G-type proteins, which in turn confirmed the existence of metabotropic glutamate receptors (mGluR). These occur in those brain structures involved in the process of establishing the dependency mechanism, as well as in the cerebral cortex [18].

So far, 8 types of mGluR have been distinguished, which have been divided into three groups. In mGluR Group I, receptors are primarily located postsynaptically, where they bind to Gq proteins, thereby activating phospholipase C (PLC) [19]. PLC catalyses the hydrolytic degradation of phosphatidylinositol (PIP2) to diacylglycerol (DAG) and inositol 1,4,5-trisphosphate (Ins (1,4,5) P3). DAG activates protein kinase C (PKC), and Ins (1,4,5) P3 stimulates the release of calcium ions from intracellular reservoirs, thus increasing their concentration in the cytosol. This first group plays a significant role in the regulation of strengthening processes [20].

The mGluR Group II occurs presynaptically and postsynaptically and weakens adenyl cyclase activity by binding to Gi/o proteins. This group is also involved in synaptic adaptation processes responsible for the chronic use of psychoactive substances. The mGluR Group II is probably involved in the development of aversive behaviour when the withdrawal of narcotic substances takes place. There is ample evidence of the involvement of the endogenous opioid system in the pathomechanism of addiction. This is indicated by the involvement of β-endorphin in the reward system [11]. The neurons that release and synthesise this β-endorphin are located primarily in the central part of the pituitary gland, as well as in the nucleus of the solitary tract. Neurons releasing β-endorphin reach the VTA and the nucleus accumbens septum and thus the important structures that make up the reward system. In both rats and humans, injections of endogenous β-endorphin into various nerve structures or into cerebrospinal fluid have a stronger effect than morphine [13].

Interestingly, the direct administration of β-endorphin to a rodent brain results in rewarding and strengthening effects. Stimulation of the opioid system changes the dynamics of dopamine release. During the self-administration of opioid agonists, there is an increase in the release of dopamine in the nucleus accumbens. GABAergic receptors stimulated in the VTA are also involved in this process [21].

Under normal conditions, these receptors exert an inhibitory effect on dopamine neurotransmission. An intraventricular infusion of β-endorphin causes an increase in dopamine release via μ and δ opioid receptors in the accumbens nucleus. This increase is also a result of the inhibiting effect of β-endorphin on the GABAergic system that blocks dopaminergic neurons [22] The interaction between β-endorphin and dopamine is bi-directional. Dopamine and β-endorphin stimulate the release of each other in the nucleus accumbens, which may result in an imbalance between these compounds [23].

This balance may be restored under the influence of other factors, e.g. increased amounts of β-endorphin (formed after ingestion of the drug) binding in the nucleus accumbens with κ opioid receptors of weaker affinity. This, in turn, leads to a reduction in dopamine levels, i.e. a weakening of the rewarding effects of the psychoactive substance [24]. GABA is the most important inhibitory CNS neurotransmitter. Three classes of its receptors have been identified, i.e. GABAa GABAb and GABAc. GABAa and GABAc are ionotropic receptors, while GABAb is metabotropic. GABA-energetic receptors in the VTA are designed to control bidirectional signalling in the reward system [25].

The three aims of the study were to check whether students take psychoactive substances during exam time, if using them causes a change in their well-being and in what ways it affects their learning outcomes.

Method and materials

Description of the study and population

An anonymous online survey about the use of psychoactive substances was conducted between 01 November 2017 and 31 March 2018. It was targeted at students of Polish universities. The author's survey was prepared using the Google Forms tool (https://www.google.pl/intl/pl/forms/about/) and published on university websites and in student group sites on Facebook. The survey consisted of 29 single and multiple-choice questions.

Results

Characteristics of the participants

610 students took part in the survey. Among the respondents, over half were men (67.2%). An adjustment was made as only 536 surveys had all questions completed. The surveyed students represented the following fields of study: medical, economic, natural science, humanities, technical and management sciences. The largest groups were technical (43.3%) and medical students (23.5%), and the smallest — economic (4.7%) and natural science students (3.5%). Detailed demographics of individual study participants are shown in Table 1.

Table 1. Demographic characteristics of the participants

Characteristic		Fields of study						
		MeS	Ec	NS	MaS	H	En	All
Number of students		126	25	19	37	97	232	536
Men, n (%)		90 (15.1)	5 (20)	5 (26.3)	5 (13.5)	7 (7.2)	148 (63.8)	360 (6.7)
Age, n (%)	Age 18–21	45 (35.7)	9 (36.0)	6 (31.6)	9 (24.3)	39 (40.2)	102 (44.0)	210 (54.5)
	Age 22–25	74 (58.7)	14 (56.0)	13 (68.4)	23 (62.2)	49 (50.5)	119 (51.3)	292 (54.5)
	Age 26–28	3 (2.4)	1 (4.0)	0 (0.0)	5 (13.5)	6 (6.2)	7 (3.0)	22 (4.1)
	Age > 28	4 (3.2)	1 (4.0)	0 (0.0)	0 (0.0)	3 (3.1)	4 (1.7)	12 (2.2)

Study Year n (%)	I	7 (5.6)	4 (16.0)	4 (21.1)	4 (10.8)	14 (14.4)	45 (19.4)	78 (14.6)
	II	29 (23.0)	2 (8.0)	3 (15.8)	6 (16.2)	21 (21.6)	64 (27.6)	125 (23.3)
	III	30 (23.8)	4 (16.0)	1 (45.3)	6 (16.2)	18 (18.6)	49 (21.1)	108 (20.1)
	IV	29 (23.0)	7 (28.0)	1 (5.3)	9 (24.3)	19 (19.6)	52 (22.4)	117 (21.8)
	V	25 (19.8)	8 (32.0)	10 (52.6)	9 (24.3)	23 (23.7)	22 (9.5)	97 (18.1)
	VI	6 (4.8)	0 (0.0)	0 (0.0)	3 (8.1)	2 (2.1)	0 (0.0)	11 (2.1)

MeS: medical sciences; Ec: economics; NS: natural sciences; MaS: management sciences; H: humanities; En: engineering sciences

Survey results

Out of 29 questions, eight, concerning problems related to substance use during exam time, were identified as the most important Figure 1A presents the percentage distribution of answers to the question: *Do you feel the effects of the so-called "rat race" during your studies?* In over 40% of cases, respondents replied that there was some competitiveness at their university, but that not all of them got involved in it. In 10% of cases students declared that it was very apparent. Only 33% of students answered that the "rat race" problem does not exist. Figure 1B presents the percentage distribution of answers to the question: *During exam time do you feel pressure from your parents to achieve the best results?* Over 1/3 of students (39.3%) felt pressure or a little pressure from their parents to achieve the best results in their studies (Fig. 1B). Figures 2A–F present the percentage distribution of answers to the question: What psychoactive substances do you use during exam time? The people completing the surveys were given a multiple choice (out of a possible eight answers). For the analysis, the results were broken down by discipline and gender.

The psychoactive substance appearing the most frequently for all students was marijuana. Among medical students, where the majority are women (84.9%), marijuana was taken by eight women (1.5%) and five men (0.9%). In comparison, among technical students, where women are in a minority (36.2%), one woman (0.2%) and 27 men took marijuana. (5.0%).

The next most commonly used substance is LSD, which appeared only among the humanities and technical faculties. It was taken by two students (0.4%) in humanities and 12 students (2.2%) in technical faculties. In the survey, substances such as caffeine, MDMA and steroids which can be used for, among other things, supporting the growth of muscle mass, appeared much less frequently.

Figures 3A–F show the percentage distribution of answers to the question: *How did the psychoactive substances make you feel?* In response, students pointed out that, among other things, using these substances helped rid them of anxiety. This answer was given by a total of 19 women (3.5%) and 9 men (1.7%) from all faculties, with the majority coming from medical students. Another reason was the desire to neutralise stress associated with exams. In total, 18 women (3.4%) and 29 men (5.4%) gave such an answer, with the majority coming from technical students. Other reasons also included the answers 'I had more energy' and 'I could study longer/learn better'.

Figures 4A–F present the percentage distribution of answers to the question: *Did you achieve better results in your studies due to the use of psychoactive substances?* Only a small group of 27 people (5%) declared that their academic performance was slightly better after using the psychoactive substance, with the majority feeling no difference or declaring that the results were the same. The only group that claimed that their results were much better were students of technical faculties, where 7 men (1.3%) from this group gave this answer,

The question: D*o you have easy access to psychotropic drugs? (e.g. antidepressants, anxiolytics)* was also asked. A very large group, as many as 72% declared that they have easy access to such drugs. However, in answer to the question: *Have you ever used psychotropic drugs during exam time?* only 8% of people admitted to their use despite this relatively easy access. The vast majority (60.6%) of respondents declared (data not shown) that they have contact with addicts. Very often immediate family — parents or siblings — appeared in the responses. The presence of addicts in the immediate environment facilitates access to psychoactive substances, and this direct contact can make it easier to become addicted. Figure 5A–F presents the percentage distribution of answers to the question: *Do you feel that you could become addicted?* Most people who gave a positive answer to the question were in the group of students from technical faculties — 17 men (3.2%). In this group and in the management sciences, no women answered in the affirmative. In the case of men, only in the group of humanities students was there no positive responses.

Discussion

Psychoactive substances have been around for a very long time, and the history of opium use dates back to the Neolithic period. Initially, they were used for mystical experiences and pain control, but over time they also became a means to improve mood. In the 1960s, with public approval, drugs began to play a significant role in socio-cultural changes. There was already, at that time, quite a lot known about the negative effects of using psychoactive substances, so their social acceptance gradually decreased, which resulted in the emergence of legal regulations regarding the issue of drug use and drug acquisition [25].

The authors of this paper developed an assumed hypothesis that the problem of accessing psychoactive substances is widespread because students tend to be linked with the use of psychoactive substances. The survey results indicate that the problem is much smaller than expected. From a group of over 500 students, only a small percentage of them admitted to using psychoactive substances. After an in-depth analysis, the authors of the survey realised that there were some flaws that potentially could have affected the result. Theoretically, an Internet-completed questionnaire could skew the results somewhat, but efforts were made to eliminate all surveys that gave the suspicion that they had been completed either incorrectly or by the wrong persons. The authors believe that an online survey is the most convenient type of questionnaire. In order to attract as many people as possible from various scientific disciplines, the survey was placed on the social networking site Facebook. There is no unequivocal evidence that the intake of a particular psychoactive substance can improve or worsen academic performance, because it is only a subjective assessment by the person completing the survey. The question *Have you ever used psychotropic drugs during exam time?* could give rise to some inaccuracies. The authors of the survey could not avoid people who suffer from mental disorders and use psychotropic drugs regularly. The results of the survey indicate the presence of the phenomenon of the "rat race" and the feeling of pressure from parents expecting the best results in their children’s studies. It is therefore likely that the need to meet these expectations may contribute to the temptation to take psychoactive substances. Our research shows that one of the most popular substances used by students was marijuana - perhaps because it has a calming and relaxing effect [26], and this gives students the opportunity to tackle their studies or exam more calmly. Research by Bolla et al. (2001) showed that about seven million people in the USA use marijuana at least once a week. Marijuana was not only popular in our own research [27]. Pach et al. [28] as well as Kułak et al. [29] also noted in

their analyses the very high popularity of marijuana. In addition, Kułak et al. showed that the subjects of their research were not aware of how marijuana works.

There is also a problem with the uncontrolled intake of psychoactive substances that are components of over the counter (OTC) medications. The profile of the pharmacological effect of the psychoactive substances available in OTC medications varies widely. Pseudoephedrine was one of the most popular over-the-counter substances selected by students in a survey conducted as part of this study. It did not only occur in the groups of economic and natural science students. Wilczyński [30] drew attention to the popularity of pseudoephedrine, especially in areas in southern Poland. The drug Sudafed, which includes the above-mentioned substance, was very popular. Students used it to give themselves extra energy while studying during exam time, maybe because they knew how pseudoephedrine works. Wilczyński's results confirm our own research regarding the popularity of this substance. Among the responses, codeine was rare, although it appeared in every group. Easier access to OTC medications can have serious consequences. Students who find solace after using easily attainable medicines available without a prescription can take further doses, which can lead to addiction. Perhaps implementing educational classes on readily available substances to increase awareness of addiction risk among students would be a good solution. Both the results obtained and the work of other authors point to different reasons for the use of psychoactive substances by students (data not shown). In the Students 2004 report (Students 2004), the majority used them for relaxation (83.1%) or to unwind (77.4%). Similar results were obtained by Pach et al. [28] confirming that the most popular reason for taking such drugs was the feeling of pleasure (72.4%) and relaxation (55%). The results of Moskalewicz et al. 1997 [31] are the most similar to our results, the desire to feel the intense effects of the drug (47.6%), fun (46.4%), relaxation (41.7%) and stress elimination (32.1%) taking the next places. Similar results came out of the research of Pietryka-Michałowska et al. [32], whose participants most often used psychoactive substances to eliminate stress (48.8%), due to poor academic results (19.4%), as well as for a feeling of pleasure. In these studies, 6.8% of respondents used psychoactive substances to improve their learning function. In these studies, more than half of the people also thought that psychoactive substances were easily available. Feelings after taking psychoactive substances can be both positive and negative. “Positive” feelings after taking drugs can lead to addiction. Students completing the survey declared positive feelings after taking a psychoactive substance (date not shown). The aim of any educational programme should be to increase awareness among students of how to safely and healthily reduce anxiety and

stress and boost the nervous system. Most often the respondents were living at home. In their opinion this makes it easier to use psychoactive substances as they avoid the problems of having to pay for lodgings, food costs, etc. All the extra money received from their parents can be used in full for their own needs, and, as research shows, also for psychoactive substances. Despite the fact that new psychoactive substances (legal highs) are not included in our research, it is also worth addressing this issue, as they are relatively popular among young people. As the research of Mazurkiewicz et al. [33] showed, the most common reasons for taking legal highs were: when meeting up with friends or attending social events, but 5.7% of respondents used them while studying. Over 60% of respondents felt positive effects from taking them, most often mentioning stimulation. Unfortunately, it must be assumed that at least some people who point out the positive effects of taking new psychoactive substances will want to take them again. The publication by Zawilska [34] should also be noted in which she pointed out that the abuse of psychoactive substances has increased dramatically since the end of 2000 all over the world. As it turns out, the most popular compounds are synthetic cannabinomimetics and psychostimulating cathinone derivatives (the so-called B-keto-amphetamines). Unfortunately, new benzodiazepines, colloquially known as "designer benzodiazepines" (DBZD), have also appeared on the market. These substances include potential drugs that have never been approved for use. Zawilska's study includes the use of DBZD, whereby she especially draws attention to poisoning with these compounds. Examples of DBZD are drug derivatives or metabolites that are used in neurology and psychiatry. They can cause similar, but more intense effects to the registered benzodiazepines. After intensive use, they may cause cognitive and motor skills deterioration, and this may result in, for example, car accidents. Regular use can lead to tolerance, leading to addiction. There is also a high risk in the case of drinking alcohol while using DBZD, which increases the risk of dying from respiratory depression.

Published reports that mainly analyse adolescents under the age of 20 should also be taken into account. One of them is the one published in 2015 by the National Bureau for Drug Prevention and the Institute of Psychiatry and Neurology of The State Agency for the Prevention of Alcohol-Related Problems [35]. In this study, the most popular psychoactive substance turned out to be alcohol, where a very high percentage of respondents admitted to exceeding the threshold of intoxication. Relatively often, young adolescents admitted using tranquilizers not prescribed by a doctor (about 17% of women). A very large group of respondents (25% among the younger, 43% among the elderly) experimented with marijuana or hashish at least once in their lifetime. It is therefore necessary to consider why

the problem arises at the stage of adolescence. Will experiments at this age not deepen in student life? The CBOS report confirmed that cigarette smoking is a relatively common problem. In the research from 2018, attention should be paid to the fragment about smoking depending on the financial situation of the family, because the differences are significant here. In the group of people who described their financial situation as good, 53% did not smoke, and in the group of people who described their financial situation as poor — 38%. Based on this, it could be concluded that in families where money is a problem, there is a greater risk of nicotine addiction [36]. The analysis of the above-mentioned reports confirms that the problem of using psychoactive substances often has its origins in adolescence. Perhaps this is due to the lack of appropriate prophylaxis, as well as insufficient psychological support. Teenagers, just like students, not coping with their problems, turn to psychoactive substances.

Conclusions

According to surveys and analysis of the work of other authors, a large group of students take psychoactive substances not only for recreational purposes, but also for relaxation and to extend their studying time. Despite their age and access to information, it appears that they are not fully aware that the consequences of these risky activities may lead to addiction. Therefore, it seems there is a need to develop and implement preventive programs at universities to raise awareness of the dangers of using psychoactive substances. Many risky behaviours undertaken in youth, including the use of psychoactive substances, can have a significant impact on adult life. This time, during their studies, is the time when young people entering the student environment may be exposed to negative patterns of behaviour. Students should therefore be kept informed of the dangers which come from taking addictive substances.

The results of surveys regarding the impact of psychoactive substances on academic results have led to the following conclusions:

1. During exam time students experience increased stress and anxiety, which may be the reason for taking psychoactive substances. These feelings are often compounded by pressure from parents expecting the best results.
2. Some students use psychoactive substances during exam time to improve concentration and learning ability.
3. Marijuana is still the most popular and easily available psychoactive substance among students. It is used to relieve stress – its use is definitely anti-educational.

4. It is necessary to consistently implement and carry out preventive measures at universities to raise awareness of the risks of using psychoactive substances
5. There are no fundamental differences between students in different academic fields

References:

1. Zawilska JB. An Expanding World of Novel Psychoactive Substances: Opioids. Front Psychiatry. 2017; 8: 110, doi: 10.3389/fpsyt.2017.00110, indexed in Pubmed: 28713291.

2. van Os J, Linscott RJ, Myin-Germeys I, et al. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis proneness-persistence-impairment model of psychotic disorder. Psychol Med. 2009; 39(2): 179–195, doi: 10.1017/S0033291708003814, indexed in Pubmed: 18606047.

3. Haney M, Hart CL, Vosburg SK, et al. Effects of THC and lofexidine in a human laboratory model of marijuana withdrawal and relapse. Psychopharmacology (Berl). 2008; 197(1): 157–168, doi: 10.1007/s00213-007-1020-8, indexed in Pubmed: 18161012.

4. Spangler R, Zhou Y, Maggos CE, et al. Dopamine antagonist and "binge' cocaine effects on rat opioid and dopamine transporter mRNAs. Neuroreport. 1996; 7(13): 2196–2200, doi: 10.1097/00001756-199609020-00028, indexed in Pubmed: 8930988.

5. Neve KA, Seamans JK, Trantham-Davidson H. Dopamine receptor signaling. J Recept Signal Transduct Res. 2004; 24(3): 165–205, doi: 10.1081/rrs-200029981, indexed in Pubmed: 15521361.

6. Purves D, Augustine GJ, Fitzpatrick D. Neuroscience. 4th ed. Sinauer Associates, Sunderland 2004.

7. Nazarian A, Sun WL, Zhou L. et. al. Różnice płci w podstawowych i wywołanych kokainą zmianach w białkach PKA i CREB w jądrze półleżącym. Psychofarmakologia. 2009; 203(3): 641–50.

8. Wang Y, Ghezzi A, Yin JC, et al. Regulacja ekspresji genu kanału BK przez CREB leży u podstaw szybkiej tolerancji na lek. Geny, mózg i zachowanie. 2009; 8(4): 369–76.

9. Obara I, Mika J, Schafer MKH, et al. Antagonists of the kappa-opioid receptor enhance allodynia in rats and mice after sciatic nerve ligation. Br J Pharmacol. 2003; 140(3): 538–546, doi: 10.1038/sj.bjp.0705427, indexed in Pubmed: 12970097.

10. Chartoff EH, Barhight MF, Mague SD, et al. Anatomically dissociable effects of dopamine D1 receptor agonists on reward and relief of withdrawal in morphine-dependent rats. Psychopharmacology (Berl). 2009; 204(2): 227–239, doi: 10.1007/s00213-008-1454-7, indexed in Pubmed: 19148621.

11. Luu P, Malenka RC. Spike timing-dependent long-term potentiation in ventral tegmental area dopamine cells requires PKC. J Neurophysiol. 2008; 100(1): 533–538, doi: 10.1152/jn.01384.2007, indexed in Pubmed: 18450581.

12. Carlezon WA, Duman RS, Nestler EJ. The many faces of CREB. Trends Neurosci. 2005; 28(8): 436–445, doi: 10.1016/j.tins.2005.06.005, indexed in Pubmed: 15982754.

13. Ford CP, Beckstead MJ, Williams JT. Kappa opioid inhibition of somatodendritic dopamine inhibitory postsynaptic currents. J Neurophysiol. 2007; 97(1): 883–891, doi: 10.1152/jn.00963.2006, indexed in Pubmed: 17122312.

14. Ebstein R, Novick O, Umansky R, et al. Dopamine D4 receptor (D4DR) exon III polymorphism associated with the human personality trait of Novelty Seeking. Nature Genetics. 1996; 12(1): 78–80, doi: 10.1038/ng0196-78.

15. Wierońska JM, Zorn SH, Doller D, et al. Metabotropic glutamate receptors as targets for new antipsychotic drugs: Historical perspective and critical comparative assessment. Pharmacol Ther. 2016; 157: 10–27, doi: 10.1016/j.pharmthera.2015.10.007, indexed in Pubmed: 26549541.

16. Bonci A, Bernardi G, Grillner P, et al. The dopamine-containing neuron: maestro or simple musician in the orchestra of addiction? Trends Pharmacol Sci. 2003; 24(4): 172–177, doi: 10.1016/S0165-6147(03)00068-3, indexed in Pubmed: 12707003.

17. Palucha A, Pilc A. The involvement of glutamate in the pathophysiology of depression. Drug News Perspect. 2005; 18(4): 262–268, doi: 10.1358/dnp.2005.18.4.908661, indexed in Pubmed: 16034483.

18. Conn PJ, Christopoulos A, Lindsley CW. Allosteric modulators of GPCRs: a novel approach for the treatment of CNS disorders. Nat Rev Drug Discov. 2009; 8(1): 41–54, doi: 10.1038/nrd2760, indexed in Pubmed: 19116626.

19. Huber KM, Kayser MS, Bear MF. Role for rapid dendritic protein synthesis in hippocampal mGluR-dependent long-term depression. Science. 2000; 288(5469): 1254–1257, doi: 10.1126/science.288.5469.1254, indexed in Pubmed: 10818003.

20. Chaki S, Yoshikawa R, Hirota S, et al. MGS0039: a potent and selective group II metabotropic glutamate receptor antagonist with antidepressant-like activity. Neuropharmacology. 2004; 46(4): 457–467, doi: 10.1016/j.neuropharm.2003.10.009, indexed in Pubmed: 14975669.

21. Roth-Deri I, Green-Sadan T, Yadid G. Beta-endorphin and drug-induced reward and reinforcement. Prog Neurobiol. 2008; 86(1): 1–21, doi: 10.1016/j.pneurobio.2008.06.003, indexed in Pubmed: 18602444.

22. Chen ZW, Olsen RW. GABAA receptor associated proteins: a key factor regulating GABAA receptor function. J Neurochem. 2007; 100(2): 279–294, doi: 10.1111/j.1471-4159.2006.04206.x, indexed in Pubmed: 17083446.

23. Luan YH, Wang Di, Yu Qi, et al. Action of β-endorphin and nonsteroidal anti-inflammatory drugs, and the possible effects of nonsteroidal anti-inflammatory drugs on β-endorphin. J Clin Anesth. 2017; 37: 123–128, doi: 10.1016/j.jclinane.2016.12.016, indexed in Pubmed: 28235500.

24. Wojnar M, Ślufarska A, Klimkiewicz A. Nawroty w uzależnieniu od alkoholu. Część 3: Społeczno-demograficzne i psychologiczne czynniki ryzyka. Alkoholizm i Narkomania. 2007; 20(1): 81–102.

25. Sztumski JW. Wstęp do metod i technik badań pedagogicznych. Wyd. Śląsk, Katowice 1995: 66.

26. Ocena rozpowszechnienia, powodów i form użycia tak zwanych „dopalaczy" przez uczestników ankiety internetowej. Psychiatr Pol. 2013; 47(6): 1143–1155.

27. Bolla KI, Brown K, Eldreth D, et al. Dose-related neurocognitive effects of marijuana use. Neurology. 2002; 59(9): 1337–1343, doi: 10.1212/01.wnl.0000031422.66442.49, indexed in Pubmed: 12427880.

28. Pach J, Tobiasz-Adamczyk B, Krawczyk E. Zjawisko zażywania substancji psychoaktywnych przez studentów medycyny, badania ewaluacyjne. Przegl Lek. 2006; 63(6): 393–397.

29. Kułak A, Shpakov A, Kułak P. Wstępna analiza problemu nikotynizmu, alkoholizmu I narkomanii w populacji studentów. Probl Hig Epidemiol. 2011; 92(1): 137–145.

30. Wilczyński P. Pseudokontrola pseudoefedryny. Tygodnik Powszechny. 2010; 34: 3–5.

31. Moskalewicz J, Sierosławski J, Świątkiewicz G. Program zapobiegania narkomanii w Polsce „Odlot". Alkoholizm i Narkomania. 1997; 2(27): 197–230.

32. Pietryka-Michałowska E, Wdowiak L. Dreher P. Zachowania zdrowotne studentów akademii medycznej. Zdr Publ. 2004; 114: 532–536.

33. Mechoulam R, Panikashvili D, Shohami E. Cannabinoids and brain injury: therapeutic implications. Trends Mol Med. 2002; 8(2): 58–61, doi: 10.1016/s1471-4914(02)02276-1, indexed in Pubmed: 11815270.

34. Zawilska JB, Wojcieszak J. An expanding world of new psychoactive substances-designer benzodiazepines. Neurotoxicology. 2019; 73: 8–16, doi: 10.1016/j.neuro.2019.02.015, indexed in Pubmed: 30802466.

35. Sierosławski J. Używanie alkoholu i narkotyków przez młodzież szkolną. Raport Krajowego Biura ds. Przeciwdziałania Narkomanii. 2015.

36. Grabowska M, Gwiazda M. Młodzież. Raport Centrum Badania Opinii Społecznej i Krajowego Biura ds. Przeciwdziałania Narkomanii. 2019.

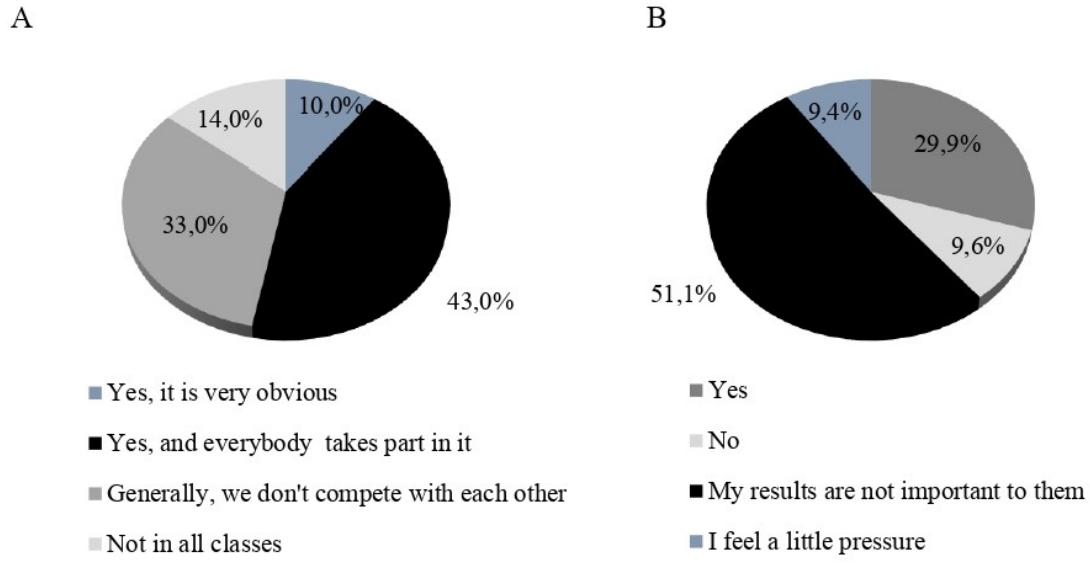

Figure 1. Response to the question: *Do you feel the effects of the so-called "rat race" during your studies?* (A) and 2: *During exam time do you feel pressure from your parents to achieve the best results?* (B)

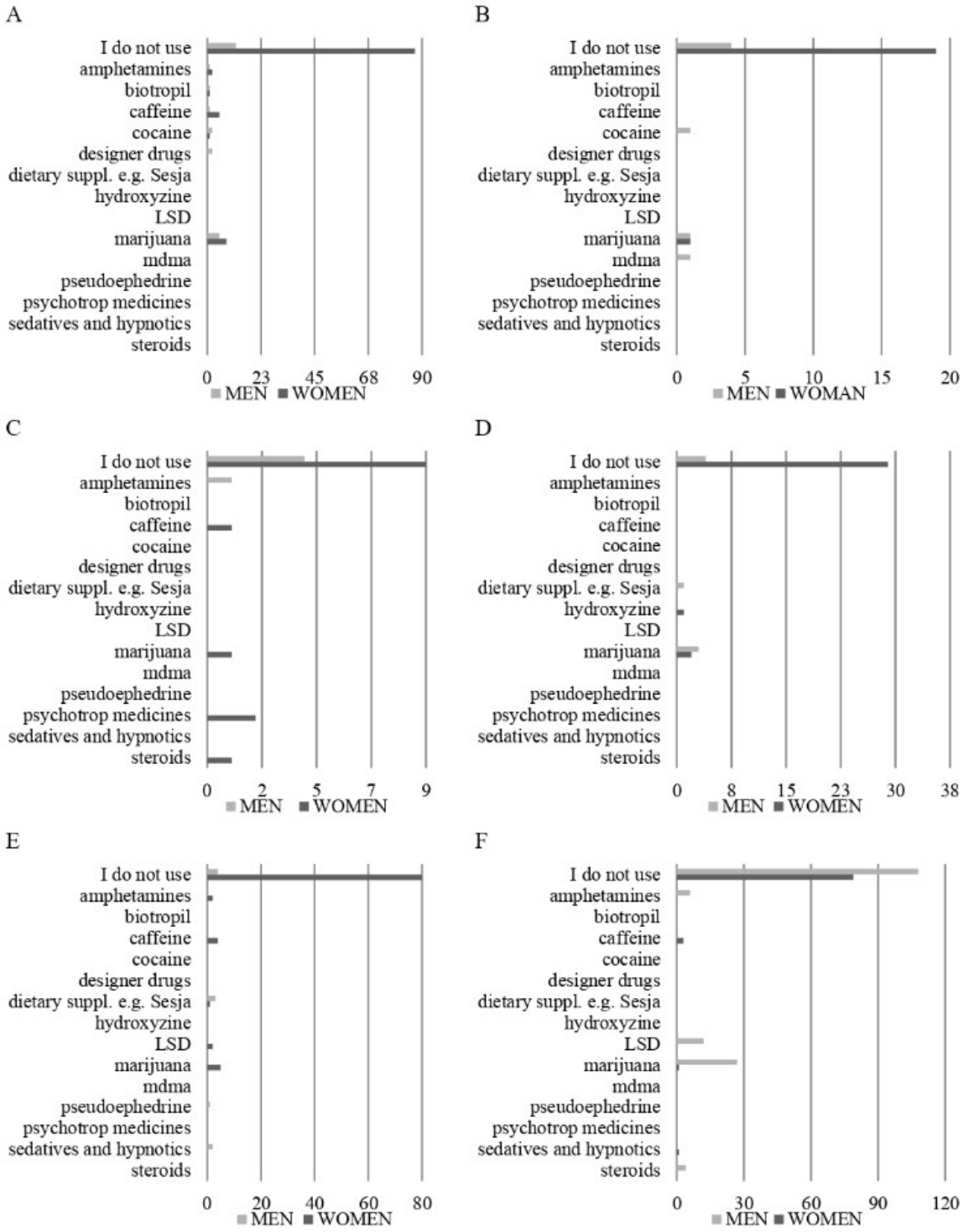

Figure 2. Answers to the question: *What psychoactive substances do you use during exam time?* (A) medical students (B) economic students (C) natural science students (D) management science students (E) humanities students (F) technical students

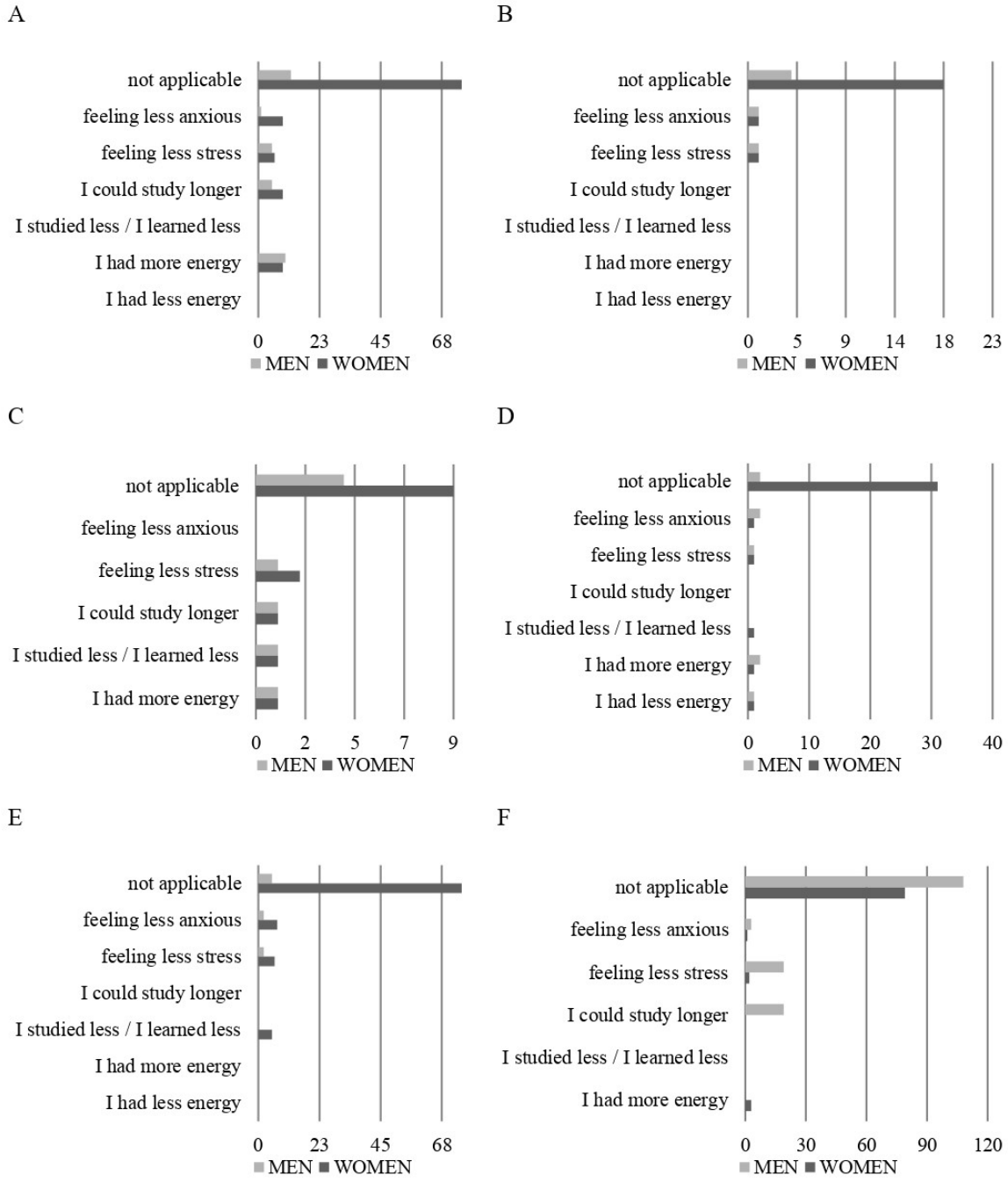

Figure 3. Answers to the question: *How did the psychoactive substances make you feel?* (A) medical students (B) economic students (C) natural science students (D) management science students (E) humanities students (F) technical students

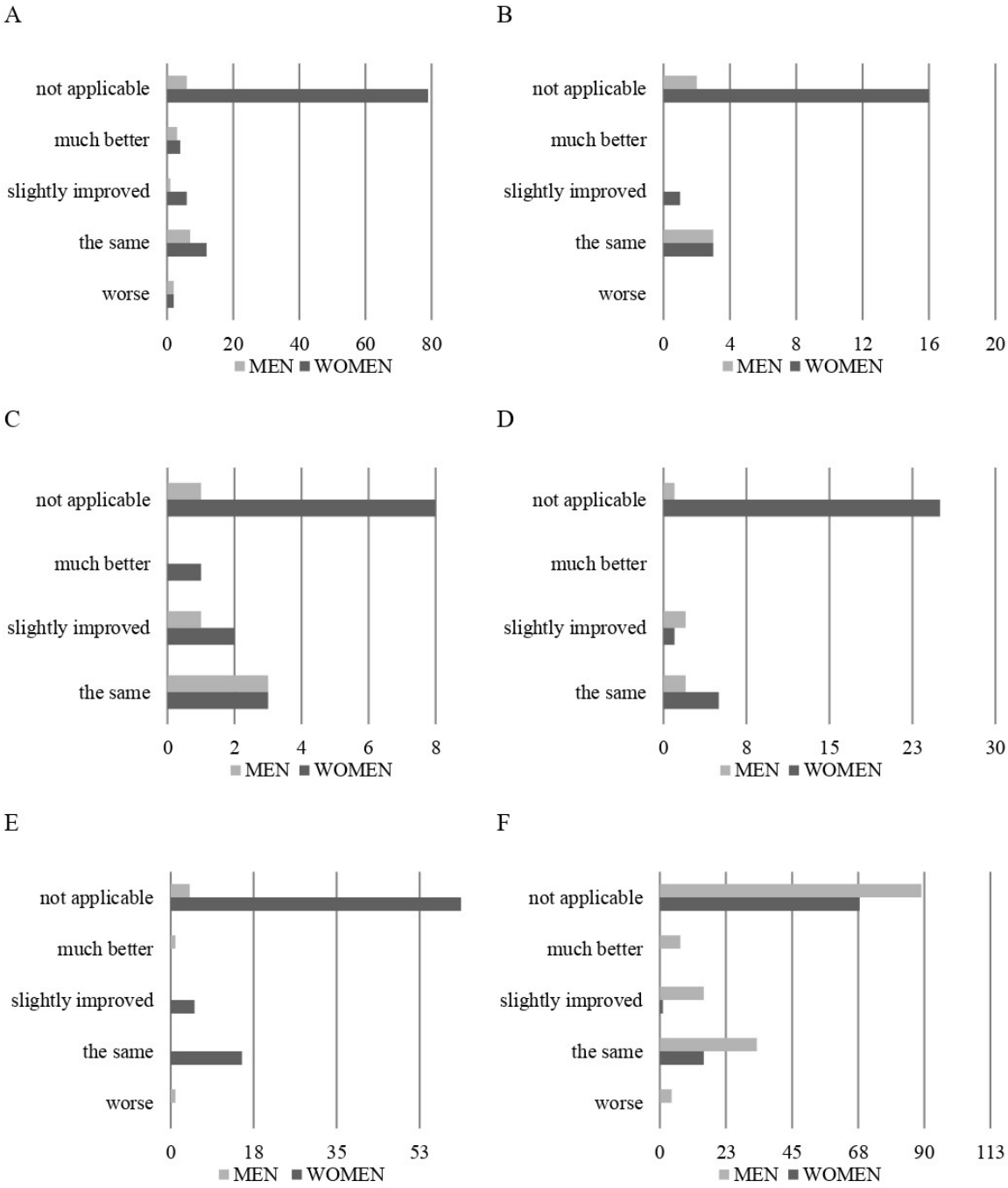

Figure 4. Answers to the question: *Did you achieve better results in your studies due to the use of psychoactive substances?* (A) medical students (B) economic students (C) natural science students (D) management science students (E) humanities students (F) technical students

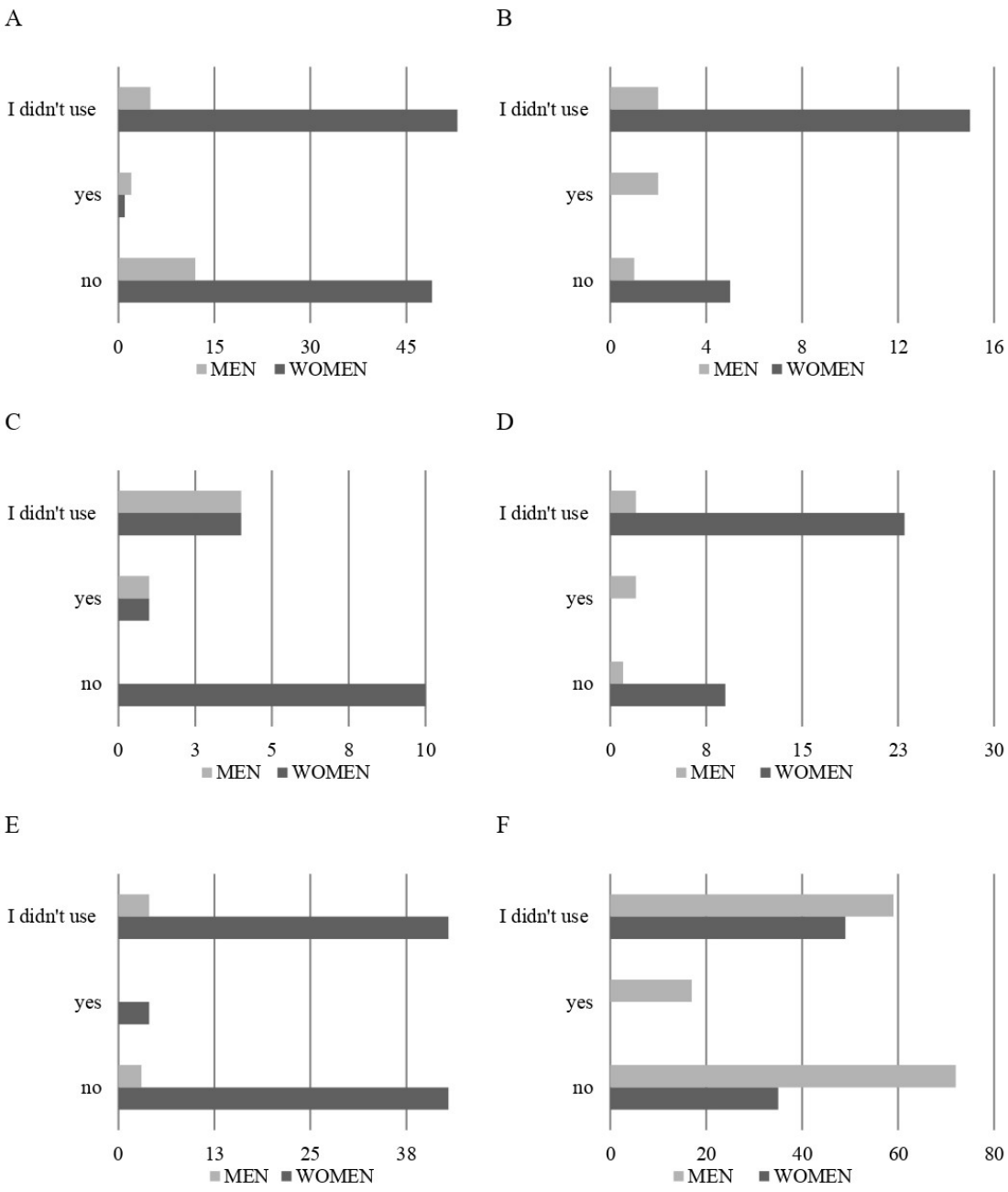

Figure 5. Answers to the question: *Do you feel that you could become addicted?* (A) medical students (B) economic students (C) natural science students (D) management science students (E) humanities students (F) technical students