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Using Beck Depression Inventory as a continuous variable as an indicator of risk of psychoactive substance use in urban 17-year-old adolescent population

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Summary

Aim. The aim of the study was to investigate whether the prevalence of self-declared depressive symptoms among adolescents attending secondary schools in Krakow is associated with increased frequency and type of psychoactive substance use, and whether depressive symptoms, viewed as a categorical or dimensional variable, may be important in detecting risk of psychoactive substance use among adolescents.

Material and methods. A cross-sectional analysis was performed in a group of 1,515 17-year-old students with the use of the *Beck Depression Inventory* and an original *Stimulants questionnaire*.

Results. The analysis of the risk of using psychoactive substances was carried out in relation to independent variables expressed as continuous variables. In the group of boys, each additional point on the Beck scale increased the overall risk of substance use by 3.3%, cigarette smoking by 2.7%, drinking alcohol by 2.7%, and drug use by 4%. In the group of girls, each additional point on the Beck scale increased the risk of substance abuse – overall by 3.7%, cigarette smoking by 3.6%, drinking alcohol by 3.1%, and drug use by 5.9%. Depressive symptoms, approached as a continuous variable, increase the risk of psychoactive substance use in both boys and girls, in particular a strong relationship is observed in the group of girls with low severity of symptoms.

Conclusions. The presence of declared depressive symptoms increases the risk of using psychoactive substances, especially alcohol and tobacco, and to a lesser extent drugs, in both boys and girls. The use of a dimensional approach made it possible to identify the relationship between increasing depressive symptoms and psychoactive substance use in the group of girls regarded as 'healthy' ('with a negative screening diagnosis') in the categorical approach.

Key words: depressive symptoms, categorial and dimensional variables, psychoactive substance, epidemiology, adolescents

Introduction

Depression, both at the level of diagnosis and symptoms (subsyndromal depression), is strongly and consistently linked to psychoactive substance use disorders [1]. In the untreated adolescent population with depression, approximately 20–30% are found to have co-occurring substance use disorders [2–5]. This phenomenon is more pronounced among adolescents than it is among adults [6–8]. Clinical observations among adolescents show higher comorbidity rates of depression and substance use disorders than in the general population [9–11].

Kandel et al. [4] showed that the prevalence of mood disorders (dysthymia, hypomania, major depression, mania) increases from about 5% in abstinent adolescents to 23.8% among adolescents who report using alcohol at least once a week and to 24.1% among those who admit to using illicit psychoactive substances at least once a year. It is also interesting to note that they found very similar rates for links between substance use and mood disorders, where comorbidity ranged from 20% to 30% with a wide range of substance use and abuse intensity from new smoking to occasional use of illicit substances.

Similar prevalence of comorbidity between depression and substance use have also been described in other epidemiological studies [3, 12–17]. The odds ratio for depression comorbidities varies significantly from study to study (ranging from 1.1 for comorbid depression with cannabis use in the Ontario study to 8.03 for comorbid substance use disorders in the Oregon study). Most studies report ratios between 1.5–2.5 [15, 18, 19].

Reflections on norm and pathology in adolescence open up the issue of sharp qualitative differences between health and disease (mental disorders), understood as a categorical approach to classification or, on the contrary, assuming a smooth, more quantitative transition between the states of norm and pathology (dimensional approach). In developmental psychiatry, the problem of norm and pathology is particularly complicated because of the adolescence period.

It is accepted that adolescence is a cultural phenomenon. It can be turbulent, riddled with anxiety, fear, sadness, a sense of being lost in the world, or harmonious, peaceful, and only in extreme cases can it cause the appearance of mental disorders. The latter approach is presented by researchers of large representative groups of adolescents, with statistical norm as the frame of reference. A representative of this approach was Daniel Offer, who opposed extrapolating phenomena observed in clinical populations to the untreated population [20, 21].

The nature of psychopathology is debated in the literature: whether the underlying psychological structure of disorders is taxonomic (categorical) or continuous (dimensional). Historically, mental disorders have been conceptualised as latent disease entities that are qualitatively different from normal functioning [22]. Numerous researchers argue that most mental disorders are arranged along a continuum from normality to pathology [23].

Supported by the DSM and ICD classification systems, traditional approaches and current practice treat depression, particularly major depression, as a qualitatively distinct syndrome. However, numerous studies suggest that a disorder may be only quantitatively different from a normal emotional experience [24]. Flett et al. [25] describe four approaches that have been used to study the continuity of depression (phenomenological, typological, aetiological and psychometric) and conclude that all available research supports the dimensional model of depression. The question of whether mental disorders are distinct nosological entities or states arbitrarily distinguished along an axis of dimensions of functioning continues to be an important issue, but the validity of this question increases as the frustrations and limitations caused by the categorical model increase.

DSM-5 and ICD-10 are categorical classifications that divide mental disorders into types based on sets of criteria containing specific characteristics. Whenever one tries to draw a line between good mental health and a disorder, one encounters a neutral territory in which there is an elusive shift from a range within the norm to disorganisation. This approach was already presented by Kreapelin in the early 20th century. The categorical diagnostic system is validated and mainly applicable in general medicine, as most cases of somatic disorders have a distinct aetiology and clearly defined pathology which allows the definition of relatively homogeneous groups [23]. These assumptions do not apply to psychiatric disorders and are increasingly being challenged. Thus, depressive disorders, anxiety disorders, schizophrenia, and bipolar disorder seem to merge elusively both with one another and with the norm with no discernible natural boundaries or zones between them. Symptoms of mental disorders appear to be highly sensitive to neurochemical, interpersonal, cognitive, and any other changes that help develop the shape and form of a particular individual instance of psychopathology. But psychological problems may not be treated in the same way as they are in general medicine. An alternative to solving this dilemma is the dimensional approach.

Aim

The aim of this study was to find out whether the occurrence of declared depressive symptoms among adolescent secondary school students in Krakow was associated with increased frequency and type of psychoactive substances used. And then, questions were raised as to whether the use of dimensional (continuous) variables in screening tools is relevant for detecting groups at risk of psychoactive substance use and whether depressive symptoms, taken as a categorical or dimensional variable, are a good predictor of the risk of psychoactive substance use among adolescents.

Material and methods

The study included second grade students (age 17) from secondary schools in Krakow, Poland. The source population of full-time second grade students was 26,429.

Based on dependent stratified cluster sampling in the proportional variant, the following were randomly selected from full-time secondary schools: public general secondary schools – 8 out of 34, private general secondary schools – 9 out of 17, technical and vocational secondary schools – 9 out of 47, basic vocational schools – 7 out of 30. All second-grade students in the randomly selected schools were included in the survey.

The percentage of absent students was similar across all school types. There were no significant differences in the percentage of students absent during the survey according to gender.

Research tools

The students were surveyed using the *Beck Depression Inventory* (BDI) and an original stimulants questionnaire. The survey was conducted anonymously, with all the questionnaires stapled together in one notebook.

The *Beck Depression Inventory* dates back to 1961. It was developed by the creator of the cognitive model of depression Aaron Beck and his colleagues. It is one of the most widely used methods for assessing the depth of depressive symptoms. It consists of 21 questions, structured as a single-choice test. It is mainly used in clinical trials of depressive conditions and in assessing the effectiveness of antidepressant medication. It is completed by the respondent (self-report scale) by selecting one of four options in relation to affirmative sentences which describe mood [26].

Respondents were asked to circle the one statement most relevant to their well-being over the past week. The overall measurement score ranges from 0 to 63 points, with higher scores indicating greater severity of depression. The criterion for inclusion in the group with a screening diagnosis of depression (mild depression) according to Beck is 10 points. Scores of 10–15 indicate mild depression, 16–23 moderate severity of depression and above 23 – severe depression. Similar values were adopted in population studies among adolescents [27, 28].

For studies conducted in the untreated population, the criterion for inclusion in the group with a screening diagnosis of depression but defined as a major depressive episode is a score of 16 points, as recommended by Kendall [29–31].

The *Stimulants Questionnaire* is a proprietary tool to assess the prevalence of psychoactive substance use (stimulants, medicines, intoxicants, drugs). The following criteria were adopted: occasional use of psychoactive substances (alcohol, cigarettes, drugs) and how often they were used less than once a week, several times a week, daily, several times a day. Data on cigarette smoking, alcohol drinking and drug use were used in the analysis due to their frequent use in the described population.

A total of 1,962 copies of anonymous questionnaires were distributed among second-grade students of all types of secondary schools. 9.1% of students were absent during the study (i.e. 196 people), 1,929 questionnaires were returned. After discarding questionnaires in which the respondents did not mark their gender (38 persons,

i.e. 2.0%), the following numbers of completed questionnaires were obtained: 1,799 questionnaires (95.1%) for the *Beck Inventory*, and 1,576 questionnaires on the use of stimulants and psychoactive substances (cigarettes, alcohol, drugs), which accounted for 83.3% of the total number. The proportion of girls and boys in all analyses was maintained and corresponded to the gender ratio of the 17–year-old population: 55% girls and 45% boys.

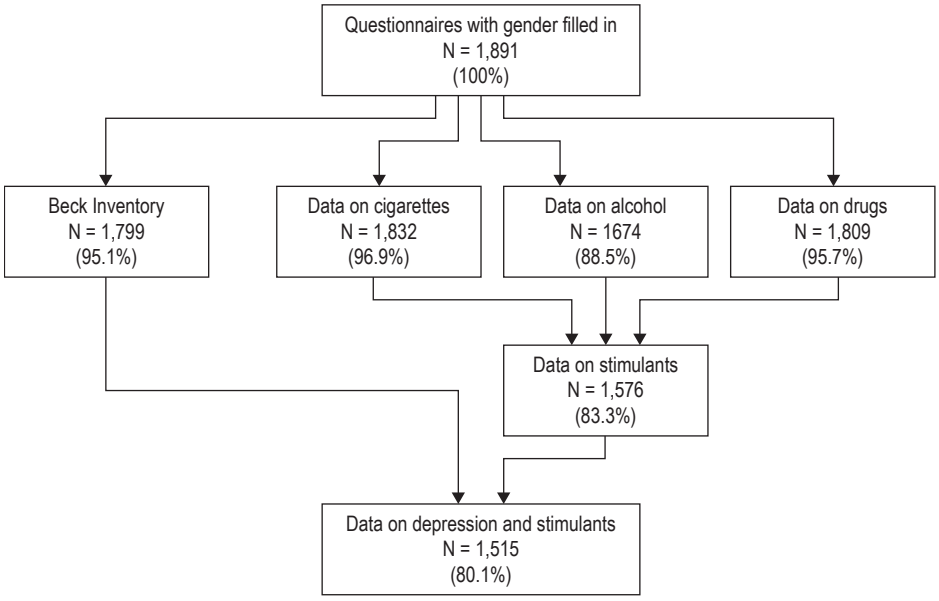

Figure 1. **Data structure in the baseline and analysed database**

Statistical analysis

The prevalence of disorder symptoms and psychoactive substance use according to respondent gender was compared using the Chi^2 test.

Further analyses were conducted separately for boys and girls. The frequency of stimulant use depending on the presence of depressive disorder symptoms was compared using the Chi^2 test or Fisher's exact test in the case of small sample sizes. Univariate logistic regression models were used to estimate the risk of using psychoactive substances depending on the presence of depressive disorder symptoms and the odds ratios (OR) were calculated with a 95% confidence interval (95%CI). Two logistic regression models were used in the risk analysis according to disorder symptom comorbidity, i.e.: (1) a univariate logistic regression model with a dichotomous independent variable (presence vs. absence of depressive symptoms) and (2) a logistic regression model with a BDI score (points) as an independent variable, overall and

by group of adolescents without depressive disorders and with a screening diagnosis of depressiveness.

All analyses were performed using IBM SPSS Statistics 28 (PS IMAGO). The significance level was set at $\alpha = 0.05$.

Results

In the analysed group (1,515 17-year-olds for whom complete responses were obtained to both the BDI and the stimulants questionnaire) the depressive symptoms, with a *Beck Inventory* cut-off point of 10 points, were presented by 23.0% of boys and 41.5% of girls ($p < 0.001$). On the other hand, if a cut-off point of more than 15 points was adopted, as recommended by Kendall for studies conducted in the untreated population, depressive symptoms were presented by 10.7% of boys and 21.1% of girls, respectively ($p < 0.001$).

Among boys, 69.7% of respondents admitted to having used any stimulants, while among girls, 65.0% did. Smoking was declared by 31.7% of boys and 35.2% of girls ($p = 0.148$), drinking alcohol was confirmed by 66.4% of boys and 59.2% of girls ($p = 0.005$), while any contact with drugs was declared by 19.8% of boys and 13.7% of girls ($p = 0.001$). The detailed results are presented in Table 1.

Table 1. **Percentage of 17-year-olds with symptoms of depressive disorders and using psychoactive substances**

	Boys ***N*** **= 666**		**Girls** ***N*** **= 849**		**Total** ***N*** **= 1515**		**Chi2-test**
	n	%	***n***	%	***n***	%	
DEP – 10 pts	153	23.0	352	41.5	505	33.3	$Chi^2 = 57.4$, df = 1, $p < 0.001$
DEP – 16 pts	71	10.7	179	21.1	250	16.5	$Chi^2=29.4$, df=1, $p < 0.001$
Psychoactive substances any	464	69.7	552	65.0	1,016	67.1	$Chi^2 = 3.6$, df = 1, $p = 0.056$
Cigarettes	211	31.7	299	35.2	510	33.7	$Chi^2 = 2.1$, df = 1, $p = 0.148$
Alcohol	442	66.4	503	59.2	945	62.4	$Chi^2 = 8.1$, df = 1, $p = 0.005$
Drugs	132	19.8	116	13.7	248	16.4	$Chi^2 = 10.3$, df = 1, $p = 0.001$

In the analysed group of 17-year-olds who declared depressive symptoms, with a *Beck Inventory* cut-off point of 10 points, any psychoactive stimulants use was presented by 75.2% of boys and 70.5 % of girls. Statistically significant differences in the frequency of use of (any) psychoactive substances between adolescents with and without depression were observed only in the girls' group (70.5% vs. 61.2%; $p = 0.005$).

When analysing individual types of stimulants, a statistically significant relationship was found in the boys' group for cigarette smoking (38.6% vs. 29.6% for depressed

(>=10 pts) and non-depressed; $p = 0.037$) and drug use (26.8% vs. 17.7%, respectively; $p = 0.014$). Among girls, depressives (>=10 BDI points) were significantly more likely to use all tested substances compared to non-depressive peers (cigarette smoking: 42.0% vs. 30.4%; $p < 0.001$), alcohol drinking: 63.6% vs. 56.1%; $p = 0.028$) and drug use: 18.2% vs. 10.5%; $p = 0.001$).

When a higher threshold was adopted for the diagnosis of depressiveness (i.e. >=16 BDI points) among boys, it was observed that the depressed group was significantly more likely to use psychoactive stimulants in general (81.7% vs. 68.2%; $p = 0.020$), cigarettes (45.1% vs. 30.1%; $p = 0.010$) and drugs (33.8% vs. 18.2%; $p = 0.002$). Among girls who declared depressive symptoms, 72.1% confirmed the use of stimulants in general compared to 63.1% ($p = 0.026$) among girl students without symptoms. As with the lower BDI cut-off point, depressed girls were more likely to use cigarettes (43.6% vs. 33.0%; $p = 0.008$), alcohol (68.2% vs. 56.9%; $p = 0.006$) and drugs (21.8% vs. 11.5%; $p < 0.001$) (Table 2).

Table 2. **Percentage of adolescents using psychoactive substances (yes/no) in relation to depressive symptoms presence**

	Boys (*N* = 666)								**Girls (*N* = 849)**							
	Psychoactive substances (any)		Cigarettes		Alcohol		Drugs		Psychoactive substances (any)		Cigarettes		Alcohol		Drugs	
	n	%	***n***	%	***n***	%	***n***	%	***n***	%	***n***	%	***n***	%	***n***	%
DEP (10 pts)																
No	349	68.0	152	29.6	334	65.1	91	17.7	304	61.2	151	30.4	279	56.1	52	10.5
Yes	115	75.2	59	38.6	108	70.6	41	26.8	248	70.5	148	42.0	224	63.6	64	18.2
OR (95% CI)	1.42 (0.94–2.15)		1.49 (1.02–2.17)		1.29 (0.87–1.90)		1.70 (1.11–2.59)		1.51 (1.13–2.03)		1.66 (1.25–2.21)		1.37 (1.03–1.81)		1.90 (1.28–2.82)	
DEP (16 pts)																
No	406	68.2	179	30.1	388	65.2	108	18.2	423	63.1	221	33.0	381	56.9	77	11.5
Yes	58	81.7	32	45.1	54	76.1	24	33.8	129	72.1	78	43.6	122	68.2	39	21.8
OR (95% CI)	2.08 (1.11–3.88)		1.91 (1.16–3.14)		1.70 (0.96–3.00)		2.30 (1.35–3.93)		1.51 (1.05–2.16)		1.57 (1.12–2.20)		1.62 (1.14–2.30)		2.15 (1.40–3.29)	

The analysis of the risk of using psychoactive substances was also carried out in relation to independent variables expressed as continuous variables. In the group of

boys, each additional point on the Beck scale increased the overall risk of substance use by 3.3% (95% CI: 1.007–1.059), cigarette smoking by 2.7% (95% CI: 1.005–1.049), drinking alcohol by 2.7% (95% CI: 1.003–1.052), and drug use by 4% (95% CI: 1.016–1.064).

In the group of girls, as among the boys, a significant association was found between the severity of depressive disorder symptoms and the use of stimulants. Each additional point on the Beck scale increased the risk of substance use – overall by 3.7% (95% CI: 1.017–1.057), cigarette smoking by 3.6% (95% CI: 1.018–1.054), drinking alcohol by 3.1% (95% CI: 1.012–1.049), and drug use by 5.9% (1.036–1.082). The detailed results are presented in Table 3.

Table 3. **Risk of use of psychoactive substances in relationship to the BDI score (continuous variable)**

BDI subsample	Psychoactive substances (any)			Cigarettes			Alcohol			Drugs		
	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*
Boys												
All	1.033	1.007–1.059	0.012	1.027	1.005–1.049	0.016	1.027	1.003–1.052	0.026	1.040	1.016–1.064	0.001
0–9	1.043	0.973–1.119	0.236	1.074	1.002–1.151	0.043	1.041	0.972–1.114	0.253	1.113	1.026–1.207	0.010
10+	1.054	0.993–1.119	0.084	1.003	0.958–1.050	0.894	1.054	0.996–1.114	0.067	1.024	0.975–1.075	0.343
0–15	1.023	0.980–1.069	0.295	1.036	0.993–1.080	0.106	1.020	0.978–1.064	0.357	1.049	0.999–1.102	0.057
16+	1.024	0.922–1.139	0.655	0.929	0.852–1.014	0.098	1.062	0.958–1.178	0.254	0.978	0.898–1.064	0.602

table continued on the next page

Girls												
All	1.037	1.017–1.057	<0.001	1.036	1.018–1.054	<0.001	1.031	1.012–1.049	0.001	1.059	1.036–1.082	<0.001
0–9	1.117	1.048–1.191	0.001	1.106	1.035–1.183	0.003	1.080	1.015–1.149	0.015	1.226	1.102–1.364	<0.001
10+	1.021	0.986–1.058	0.244	1.013	0.982–1.045	0.407	1.03	0.996–1.066	0.084	1.057	1.019–1.096	0.003
0–15	1.066	1.027–1.107	0.001	1.075	1.035–1.116	<0.001	1.037	1.001–1.075	0.045	1.099	1.040–1.161	0.001
16+	1.035	0.974–1.099	0.266	1.009	0.960–1.061	0.714	1.014	0.960–1.071	0.627	1.066	1.008–1.128	0.025

The relationships between Beck scores and psychoactive substance use were additionally analysed separately for the group of individuals without symptoms of depressive disorders (with a cut-off point of 10 points on the *Beck Inventory*) and with symptoms of such disorders. In the group of boys without symptoms of depressive disorders (cut-off point at 10 points) a statistically significant increase in the risk of drug use was observed, with each additional point on the Beck scale being associated with 11.3% higher risk (95% CI: 1.026–1.207).

In contrast, in the group of girls, a significant increase in the risk of substance use was observed in the group without symptoms of depressive disorder (cut-off point at 10 points). Thus, each additional point on the Beck scale was associated with a higher risk of substance use – by 11.7% overall (95% CI: 1.048–1.191), for cigarette smoking by 10.6% (95% CI: 1.035–1.183), for drinking alcohol by 8% (95% CI: 1.015–1.149), and for drug use by 22.6% (95% CI: 1.102–1.364). The risk of drug use in the group with symptoms of depressive disorder increased by 5.7% with each point on the Beck scale (95% CI: 1.019–1.096).

Assuming a higher cut-off point (16 points) on the *Beck Inventory* in the group of girls without symptoms of depressive disorder, a statistically significant relationship was observed between the *Beck Inventory* score and the risk of psychoactive substance

use. Each additional point in the Beck score was associated with a 6.6% increase in the risk of overall stimulant use (95% CI: 1.027–1.107), cigarette smoking by 7.5% (95% CI: 1.035–1.116), drinking alcohol by 3.7% (95% CI: 1.001–1.075), and drug use by 9.9% (95% CI: 1.040–1.161). In girls with symptoms of depressive disorder (cut-off point 16 points), a statistically significant relationship was only observed for drug use. The estimated odds ratio was 1.066 (95% CI: 1.008–1.128), meaning that each additional point on the Beck scale increased the risk of drug use by 6.6%.

Discussion

The study confirmed the coexistence of the depressive symptoms and use of certain psychoactive substances in the population of a large university town such as Krakow.

The occurrence of declared depressive symptoms (screening diagnosis of mild depression with a cut-off point of 10 points in *Beck Inventory*) is linked to cigarettes and drugs in boys, while in girls it is linked to stimulants in general, smoking cigarettes, drinking alcohol, and taking drugs.

The basic assumption of the study in question was to approach the declared depressive symptoms merely as a basis for screening and those which may possibly be approached as subliminal symptoms of disorders, occur independently and do not constitute the basis for a nosological diagnosis. They were only intended to provide a basis for describing phenomena that co-occur at a certain point in time in adolescents in middle adolescence. The tools were selected for their ease of use in large epidemiological studies and the ability to compare them with previously obtained results. Self-report questionnaires were used describing phenomena of which the respondents are aware. It is known from previous studies that the reliability of information obtained from developmental age patients increases with age, while the reliability of information given by their parents decreases sharply [32]. The study was anonymous, which was done intentionally to be able to assess the prevalence of psychoactive substance use as reliably as possible.

It was also determined that the occurrence of declared depressive symptoms (screening diagnosis of depression with moderate intensity of symptoms with a cut-off point of 16 points in *Beck Inventory*) among boys and girls is associated with the use of stimulants in general, cigarettes and drugs. In girls, it is additionally associated with alcohol use. All relationships are statistically significant.

According to reports by the World Health Organisation (WHO), there has been a significant increase in alcohol consumption among adolescents in most countries in recent years. It is apparent that early-age drinkers are a risk group for developing future alcohol dependence, use of other psychoactive substances and smoking [33, 34]. The results of an epidemiological, longitudinal study on a population of 10,800 individuals (from adolescence to early adulthood) indicate that the relationship between depressive symptoms and substance abuse is bidirectional. Greater levels of depressive symptoms in adolescence are associated with more frequent substance abuse in

early adulthood. More frequent substance abuse is associated with greater severity of depressive symptoms several years later. This association is stronger in girls than in boys [35]. The influence of depressive symptoms in adolescents on cigarette smoking in this age group has been increasingly described in recent years [36].

It was also noted that 'below' the level of a categorical diagnosis, there are also important levels of symptoms. Anxiety symptoms, depressive symptoms, cognitive problems, attention problems, and aggressive behaviour may be approached in this way. These are only revealed through dimensional constructs such as the CBCL (*Child Behaviour Checklist*) or the KID (*Krakow Depression Inventory*) used in Polish settings. The application of the dimensional approach allows the assessment of dimensions defined not as separate units, but as a continuous representation of different important problem areas [37, 38].

Approaching the *Beck Inventory* scale as a continuous, i.e. dimensional scale reveals that the risk of using psychoactive substances in a group of adolescents, who are of no interest to researchers or clinicians and are not treated as a risk group in most epidemiological and clinical studies, showed that various emotional states of adolescence may also pose a risk for using stimulants as a way of solving the adolescent crisis. When analysing a group of adolescents with *Beck Inventory* scores below 10 points, it was observed that each additional point on this scale increases the risk of using psychoactive substances: cigarettes, alcohol and drugs in both boys and girls.

Thus, the obtained results provide yet another argument in the on-going discussion on the use of a categorical classification system in developmental psychiatry and advocate a dimensional approach in the presence of depressive symptoms and confirm the role of the latter as a risk factor for the development of psychoactive substance dependence, even when symptom intensity is low. The results presented in this study indicate a great need for the preparation and implementation of modern prevention programmes for adolescents in the developmental period, which, due to the prevalence and increase in the phenomenon, should be implemented in the schools they attend.

Conclusions

1. The presence of declared depressive symptoms increases the risk of using psychoactive substances, especially alcohol and tobacco, and to a lesser extent drugs, in both boys and girls.
2. Depressive symptoms, approached as a continuous variable, increase the risk of psychoactive substance use in both boys and girls, in particular a strong relationship is observed in the group of girls with low severity of symptoms.
3. The use of a dimensional approach made it possible to identify the relationship between increasing depressive symptoms and psychoactive substance

use in a group of girls regarded as 'healthy' ('with a negative screening diagnosis') in the categorical approach.

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