

Prediction of Risk for Boys' Involvement in Drug Use Based on Levels of Self-evaluations in Russia

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ABSTRACT

Background: Adolescents often experiment with drug use, which can impact on their health and well-being and increase the probability of problem drug use. Yet, not enough is known about which psychological indicators is related with the initiation of drug use among young adults and have predictive power. **Materials and Methods:** Participants in this study were 311 boys (school and college students) aged 15–17. Data were collected in the towns of Moscow region. A modified version of Dembo-Rubinstein test was used to assess the self-evaluation (SE). A questionnaire and detection of drugs in urine were used to identify drug users. Binary logistic regression analysis based on SE with the inclusion of interactive effects between predictors was used for prediction of drug use. **Results:** Drug users, compared to nondrug users, are characterized by lower actual SE of health, happiness, success in learning, mind and desired SE of appearance, and higher desired SE of relationships with friends. The developed nonlinear regression model for prediction of boys' involvement in drug use among young boys in the towns of Moscow region has a sensitivity of 82.7% at a specificity of 79.0%. **Conclusions:** Dembo-Rubinstein test of SE is a sensitive measure to identify boys at risk of involvement in drug use. Application of the regression model based on SE may contribute to the useful solution in preventing any onset of early drug use.

Key words: *Adolescents, drug use, logistic regression, school, self-evaluation*

INTRODUCTION

The problem with personality risk factors for drug use in adolescence is becoming more urgent in view of the high prevalence of the younger generation drug use.^[1,2] Although adolescent drug use has been studied for a long time, still there is a need to develop diagnostic means to identify psychological indicators of early-stage drug use.

Self-evaluation (SE) of important personal qualities and values can be an indicator of the propensity to use drugs. SE contradictions of male youths who abuse hashish were described by:^[3] propensity to self-abasement and self-denial combined with social

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courage and lowered self-criticism. Based on the study of SE structure of opium addicts, Tkhostov *et al.*^[4] have concluded about the uncertainty and inadequacy of their self-concept. Contradictory features of the addictive personality are allocated: Demonstration of superiority combined with an inferiority complex; external sociability and friendliness combined with the lack of a stable emotional relationship.^[5]

High or low SE of important personal qualities typically indicates the presence of a sense of well-being or ill-being related to these qualities. Drug use is associated with self-devaluing implications of school peer communication, and exacerbation of self-esteem motive, which students try to realize in deviant structure,^[6] poor school achievements.^[2,7,8]

The current study sought to investigate the differences in the SE of personal qualities between boys who had used drugs and those who had not, residing in the towns of Moscow region, and to develop a logistic regression model for prediction of boys' drug use prior to seeking help.

MATERIALS AND METHODS

Participants

Participants in this study were 311 boys aged 15–17, residing within the city limits of the three towns of Moscow region. Participants with missing values for the drug consumption at baseline were excluded ($n = 7$) from the study. Hence, the sample includes 114 humanities and technical school students and 197 college students who mastered the profession mechanic and chef confectioner. All students were invited to participate if they provided written parental consent and student assent. The participants in this study were part of a survey conducted between November 2009 and May 2010 to identify adolescents' substance use.

Procedure

Anonymous and voluntary testings were administered by a psychologist and trained social workers during a 45 min classroom period. The self-report respondents were given clarification as to the meaning of "drugs" (club drugs, over-the-counter drugs, and prescription drugs). All procedures were approved by the Departments of Education in each town.

Measures

Drug use

The participants completed a questionnaire, containing questions about age, gender, and drug use (the question "Do you use any drug?" with a simple yes or no response). The test for detection of drugs (amphetamines, cannabinoids, and opioids) in urine was also used. Often, self-report is a valid measure

of substance use,^[9] but adding urine tests improves detection of drug use.^[10]

Self-evaluation

A modified version of Dembo-Rubinstein test^[11,12] was used to assess SE. Recently this method was used to establish the links between sources of self-worth and its height in a variety of important areas.^[13]

The modified Dembo-Rubinstein methodology includes along with the basic scales ("health," "mind," "character," and "happiness"), scales "appearance," "success in learning," "relationships with teachers," "relationships with parents," "relationships with friends," and "self-confidence." Scale "handwriting" was introductory. Each scale was depicted as a vertical line of length 12 cm, on which the respondents made three signs, representing three SE levels: Actual level, desired level, and achievable level. At studying of SE, the values of actual, desired, and achievable SE for each scale were measured.

Internal consistency of primary baseline variables

The Pearson's correlation coefficients between particular pairs of SE indexes were positive and varies from a low of 0.028 (between "actual mind" and "desired happiness," $P = 0.309$) to a high of 0.822 (between "actual relationships with parents" and "achievable relationships with parents," $P < 0.001$). Good internal consistency reliability was demonstrated for the total scale (Cronbach's alpha based on standardized items = 0.917, $n = 30$). Alpha coefficients for each subscale are as follows: 0.823 for actual SE ($n = 10$), 0.845 for achievable SE ($n = 10$), and 0.799 for desired SE ($n = 10$). The deletion any item decreases alpha coefficient for the total scale and subscales.

The multicollinearity tests (R^2 vs. other independent variables and associated variance inflation factors [VIF]) of the independent variables are acceptably low for each of the thirty independent variables (the highest value of VIF is 5.52 [for "achievable relationships with parents"], whereas the mean VIF is 3.39).

Statistical analysis

The dependent variable in regression analysis is a dichotomous variable "drug users/non-users of drugs." In a standard setup, we used univariable binary logistic regression, followed by multivariable logistic regression analysis with the inclusion of interactive effects between predictors to estimate associations between use versus nonuse of drug. Series of prediction equations were obtained on the basis of all the original 30 SEs with several significance levels. The inclusion of interactive effects between predictors allows constructing a number of logistic regression models, which are formally

providing 100% prediction of the dependent variable. However, the suitability of these bulky models (with several tens of predictors) for practice is not obvious. Thus, the choice of models with interactive effects between predictors was based on the analysis of structural stability for the five pairs of training and control groups. For this purpose, the sample was divided into two parts – training (80% of cases) and control (20% of cases). Because this way you can get five nonoverlapping control groups and corresponding five training groups, we have five structurally identical models based on the examples that were not included in the control group and differed only by numerical coefficients of the predictors. The structural stability of the model was assessed by comparing the mean area under the receiver operating characteristic (ROC) curves (AUC) and the mean accuracy of the predictions for the corresponding five control groups. It turned out that the adequacy of the models with the external addition (i.e., the data of the respondents, which are not involved in model construction) drops sharply with increasing number of predictors above a certain number. Finally, studentized residuals analysis was conducted to identify and examine indicators.

Computer package SPSS version 15.0 (SPSS, Chicago, IL, USA) was used for all analyses.

RESULTS AND DISCUSSION

Sample characteristics

According to the results of the survey, 56 (18%) of 311 boys use drugs [Table 1]. The urine drug test gave a positive result in 26 of the drug users (this means that these respondents used drugs no more than about 4 days ago). Drug users include also participants who self-reported they did not use drugs but have a positive urine test. Over-reporters were defined as indicating a consumption of a specific drug during the preceding 4 days which was not confirmed by the urine screening. Amphetamines were the drug used by most of the drug users. For comparison, studies of boys in North America, Western Europe, and Australia show the preference for cannabis use.^[1,14] Boys were significantly more likely to report cannabinoids use [Table 1]. It is possible that students do not hold strong negative perceptions

related to cannabinoids, which are in contrast with use of other more stigmatized drugs. This is also illustrated by the finding^[15] that male participants are more likely to report nonmedical prescription stimulant compared to other illicit stimulant drug use.

To combine in one sample of school and college students, the SEs of school and college students were compared by the Wilcoxon-Mann-Whitney and Kolmogorov–Smirnov criteria. Statistically, significant differences were not detected ($P > 0.05$). To combine in one sample of respondents of different ages, SE of the three subsamples (15 [$n = 100$], 16 [109], 17[102] years old students) were compared with the use of variance analysis, the Spearman's criterion, and the Kolmogorov–Smirnov criterion. No statistically significant differences were detected ($P > 0.05$), which suggests that in this age period changes of SE are not associated with age.

Relationship between self-evaluation and drug use

The most informative parameters of SE (predictors) were examined by univariable binary logistic regression for the probability P of assigning respondents to the category of drug users for given values of predictor x , revealing a multiplicative (exponential) relationship between SE and drug use [Table 2]. Odds ratios (OR) calculated with respect to changes of the predictor x on 1 point equals 1 cm.

$$OR(x) = \frac{\frac{P(x+1)}{1-P(x+1)}}{\frac{P(x)}{1-P(x)}} = \exp(B),$$

$$P(x) = \frac{1}{1 + \exp(-B_0 - B \cdot x)}$$

The irregularity of the actual SE occurs mainly at the expense of reducing SE on the scales of “health,” “success in learning,” “happiness,” and “mind” [Table 2]. The desired level of SE has proved significant in two parameters, according to the regression the drug users have a higher level on a scale of “relationships with friends” and less high on the scale of “appearance.”

Table 1: The urine drug test and self-reported experience of psychoactive drugs

Drugs	Urine test and self-reported	Only urine test	Drug users	Nondrug users	All users (n)
Only cannabinoids	5	0	5		
Cannabinoids and amphetamines	4	0	4		
Only opioids	1	5	6		
Opioids and amphetamines	0	2	2		
Only amphetamines	2	7	9		
Only self-reported			30		
Total	12	14	56	255	311

Thus, SE of drug-using boys finds some contradiction. The unevenness of actual SE was due to some decrease in SEs of basic values (health, happiness, and mind), which is consistent with findings from other studies that noted the feeling of dissatisfaction and lower self-attitude of drug users.^[3,5,6,16] The increase of SE of relationship with friends at the desired level confirms the data on the role of friends in involvement in psychoactive substances use.^[2,6,8,17-19]

Lower actual SE of success in learning of students using drugs compared to nonusers confirmed by other studies.^[2,7,8] The lack of academic success may lower self-esteem since the school rating is a key indicator of learning achievement.^[20] If for any reason the learning is difficult, school failure as a stress source can be a risk factor for drug initiation.

Binary logistic regression model for risk assessment of drug use

At the beginning, five models with linear predictors were obtained on the basis of all original 30 SEs with the sequential elimination of predictors for significance levels of more than 0.05, 0.1, 0.15, 0.2, and 0.25, respectively. Then, a number of models were derived from these five basic models by choosing various levels of significance and using the standard turn-based procedures “inclusions with exceptions” from the full set of predictors and all their pair interactions. The final version of the model with the best predictive ability for control groups

was obtained with a significance level of 0.20. This 13-item logistic regression model is significant with positions of likelihood ratio statistics $\chi^2(13) = 68.1$, $P < 0.0001$, and the coefficient of determination Nagelkerke R^2 was 0.337 [Table 3]. The results of ROC analysis give a value of $AUC = 0.812$, which allows to evaluate the quality of the model as good. For a threshold cut-off (CUT) = 0.193, chosen from the condition of maximum total sensitivity and specificity of the model, the correct predictions were 79.0% for nondrug users and 82.7% for drug users.

Table 3 also shows the results of checking the structural stability of the model. In all cases, set the baseline CUT = 0.193. There is some expected (in particular, due to a 20% reduction in the volume of the training groups, when we determined coefficients of the model) decrease mean value of AUC and mean correct prediction counted in five control groups. For these five submodels, the maximum deviations (relative and in units of standard deviation [SD] m) of the coefficient of determination Nagelkerke R^2 and AUC were 3.4% (1.50 m) and 13.3% (1.62 m), respectively, and correct predictions for nondrug users and for drug users were 7.2% (1.53 m) and 6.8% (1.10 m), which are considered as acceptable, indicating that the model has good structural stability.

Coefficients of the logistic regression model for the probability P_{mark} of assigning respondents to the category of drug users for given values of x_i ($i = 1, 2, \dots, 13$).

Table 2: The relationship of standard error with drug use, according to the univariable regression analysis

Self-evaluation	Mean±SD	B (P)	SE	Wald	Exp (B) (OR)	95% CI for Exp (B)
Actual SE						
Health	8.39±2.28	-0.157 (0.013)	0.063	6.13	0.855	0.755-0.968
Success in learning	6.76±2.49	-0.154 (0.012)	0.061	6.33	0.858	0.761-0.967
Happiness	8.05±2.73	-0.111 (0.037)	0.053	4.35	0.895	0.806-0.993
Mind	7.19±2.10	-0.143 (0.045)	0.071	4.02	0.867	0.754-0.997
Desired SE						
Relationships with friends	11.12±1.34	0.326 (0.038)	0.157	4.32	1.386	1.019-1.885
Appearance	9.91±2.06	-0.143 (0.043)	0.071	4.09	0.867	0.755-0.996

P – Significance level (if it is less than the predefined alpha level [0.05 in this test], the variable is statistically significant). $n=311$, 56 – drug users. *B* – Regression coefficient; *SE* – Standard error; *Wald* – Criterion of Wald (the test statistics would be χ^2 [0.05; $n=1$]=3.84); *OR* – Odds ratio; *CI* – Confidence interval; *SD* – Standard deviation

Table 3: Parameters of the regression equations linking the probability of assigning respondents to the category of drug users P_{mark} with complex self-evaluations

Respondents, n (%)	-2 log likelihood	Nagelkerke (R^2)	AUC	CUT	Nondrug users (%)	Drug users (%)
100	208.6	0.337	0.812	0.193	79.0	82.7
5×20						
Mean±SD	164.9±1.65	0.348±0.008	0.765±0.063	0.193	75.8±3.6	75.1±4.6
Minimum	162.6	0.336	0.663		71.4	70.0
Maximum	167.1	0.356	0.831		81.3	80.0

$n=311$, 56 drug users. -2 log likelihood – -2 Log likelihood statistic; Nagelkerke (R^2) – Pseudo coefficient of determination; AUC – Area under the ROC-curve; ROC – Receiver operating characteristic; CUT – Cut-off; SD – Standard deviation

$$P_{\text{mark}} = \frac{1}{1 + \exp\left(-B_0 - \sum_i B_i \cdot x_i\right)}$$

are presented in Table 4. The multicollinearity test of the independent variables [Table 4] is acceptably low for each of the thirteen independent variables ($VIF_i = 1/(1-R_i^2) < 4, i = 1, 2, \dots, 13$).

Studentized residuals analysis was conducted to identify and examine indicators that were predicted by the model incorrectly. The number of points that do not fit into two SDs is 2.6% and insignificant. Cook's distance for the two observations have values above 1; however, no other reasons for exclusion of their cause were found.

The results of White^[21] test for heteroskedasticity indicate that there is no significant both heteroskedasticity and specification bias problems for the developed nonlinear model. The Lagrange multiplier test statistic is $N \times R^2 = 122.8$ from an auxiliary regression of the squared residuals on the original regressors and all their squares with 183 explanatory variables for $N = 311$ observations (the test statistics would be $\chi^2 [0.05; 182] = 214.5$).

Despite the insignificance of some individual independent variables that is responsible for the drug use, the hypothesis of their common insignificance cannot be rejected at the 20% significance level [Tables 2 and 4]. For example, the individually insignificant regression coefficients for the actual

self-confidence and actual appearance are jointly significantly ($P = 0.006$ and 0.008 , respectively) responsible for the drug use. Note also that the logistic regression model for the probability P_{mark} does not include the actual mind from Table 2.

Part of the calculated coefficients (for actual SE of happiness and health; achievable SE of success in learning; desired SE of happiness and appearance; paired predictors "desired SE of success in learning/actual SE of relationships with friends" and "achievable SE of character/achievable SE of happiness") have a negative sign [Table 4], i.e., the less concerned SE, the greater the chance that the respondent is a drug user. A significant association of the reverse nature is observed only for actual SE of relationships with friends, achievable SE of self-confidence, desired SE of success in learning, paired predictor "desired SE of happiness/actual SE of health."

For the purpose of identifying the important factors, which are sensitive to drug use, in Table 4 the odds ratios also shown. SE of "relationships with teachers" is not appeared in our study.

LIMITATIONS AND CONCLUSION

The developed logistic regression model showed good prognostic properties to predict drug use based on the levels of SE. However, the model is newly developed and only based on empirical data for boys who were school and college students in the towns of Moscow region. Our findings indicate that the Dembo-Rubinstein test is a sensitive tool to identify boys at risk of involvement

Table 4: Binary logistic multivariable regression model with the inclusion of interactive effects between predictors

Items	χ_i	VIF _i	B _i	SE	Wald	Significant	Exp (B _i) (OR _i)	95.0% CI for Exp (B _i)
0	Constant B ₀		-5.970	6.851	0.76	0.384	0.003	
	Actual SE							
1	Health	1.40	-2.116	0.746	8.05	0.005	0.121	0.028-0.520
2	Relationships with friends	3.45	1.374	0.557	6.07	0.014	3.950	1.325-11.781
3	Happiness	1.62	-0.252	0.084	9.02	0.003	0.777	0.659-0.916
	Achievable SE							
4	Self-confidence	3.61	0.539	0.154	12.24	0.000	1.714	1.268-2.319
5	Success in learning	2.04	-0.237	0.101	5.49	0.019	0.789	0.647-0.962
	Desired SE							
6	Success in learning	2.02	1.712	0.559	9.39	0.002	5.540	1.853-16.563
7	Happiness	1.47	-0.967	0.466	4.30	0.038	0.380	0.152-0.948
8	Appearance	2.06	-0.436	0.119	13.35	0	0.647	0.512-0.817
	Interactive effects							
9	(Desired Happiness)*(Actual Health)		0.173	0.065	7.05	0.008	1.189	1.046-1.351
10	(Desired success in learning)*(Actual relationships with friends)		-0.139	0.051	7.33	0.007	0.871	0.788-0.962
11	(Achievable Character)*(Achievable Happiness)		-0.015	0.007	4.71	0.030	0.985	0.973-0.999
12	(Achievable appearance)*(Actual self confidence)		0.017	0.009	3.55	0.059	1.018	0.999-1.036
13	(Desired relationships with parents)*(Desired health)		0.018	0.010	2.98	0.084	1.018	0.998-1.039

VIF_i – Multicollinearity test of the independent simple variable χ_i . SE – Standard error; OR – Odds ratio; CI – Confidence interval; B – Regression coefficient; VIF – Variance inflation factor

in drug use among young boys. Application of the regression model to identify boys at risk of involvement in drug use will contribute to optimize the solution to the problem of early drug use prevention. Future longitudinal studies will be able to examine the major findings.

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Conflicts of interest

There are no conflicts of interest.

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