INVESTIGATION OF INTERNALIZING AND EXTERNALIZING SYMPTOMS AMONG ADOLESCENTS AND YOUNG ADULTS WITH HIGH RISK FOR THE DEVELOPMENT OF SUBSTANCE USE PROBLEMS

PhD thesis

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I. INTRODUCTION

Adolescence and young adulthood are significant periods of one's life regarding the onset of problematic substance use, since the abuse of alcohol, tobacco and illegal substances regularly start in these life periods. Regarding the development of substance use disorders, adolescence is considered to be a critical period of life, since substance use and dependence occurring in this life period are very likely to lead to addiction in adulthood, medical treatments, comorbid psychiatric disorders, physical illnesses and death. Among the bio-psycho-social risk factors for substance use disorders the transition to primary school into secondary school (which coincides with the transition to early adolescence to adolescence) is a very significant one, which makes young adolescents vulnerable for psychological problems. This transition period proceeds around ninth grade. In young adulthood additional risk factors occur, which increases the likelihood of the first use of psychoactive substances and of the development of substance use disorders. In adolescence and young adulthood the identification of risk factors for substance use disorders are vital for preventive and interventive purposes. Studies aimed at the identification of psychopathological problems which are co-occurring with substance use disorders fit to this avenue of research endeavor. The clinical experience and scientific knowledge of the co-occurrence of psychological symptoms and substance use disorders constitute to the empirical basis of this research approach. Epidemiological studies conducted on population and clinical samples among young adults and adolescents identified three main dimensions of mental disorders: internalizing disorders (e.g. symptoms of depression, anxiety disorders, suicidal behavior and psychosomatic problems), externalizing disorders (e.g. Attention Deficit, Hyperactivity Disorder (ADHD), impulse control disorder, antisocial behavior and aggressive behavior) and substance use disorders. The associations among externalizing and internalizing disorders and substance use disorders are documented in the literature in clinical and population samples among young adults and adolescents.

II. OBJECTIVES

The dissertation's objectives to shed light on the characteristics of problematic substance use in two age groups. Both the transition to adolescence from young adolescence (9^{th} grader age, 13-15 years of age) and the transition to adulthood from adolescence (young adulthood 18-25 years of age) associated with biological, psychological and social changes, make young people vulnerable to develop substance use disorders. From the perspective of problematic substance use the first transition period can be viewed as a preaddictive stage and the second

one as an addictive stage (significant for the development of substance use disorders). The main aim of this study was the identification of such psychopathological symptoms which can be identified as additional risk factors for the development of substance use disorders in these vulnerable life periods. By identifying these factors adequate preventive and interventive strategies can be implemented. In both age groups we wanted to examine the severe forms of substance use characteristic for the given age group. Thus the main research question in adolescence was the examination of the associations among the co-use of alcohol drinking and tobacco smoking and symptoms of psychopathology (physical aggression, bullying, symptoms of ADHD and emotional problems). In the sample of young adults – for the same reasons – the main research questions were the investigation of the characteristics of illegal substance use and the associations among illegal substance use and symptoms of psychopathology. In both age groups, psychometric validation of new psychometric measures was an additional important aim.

Hypotheses of the study conducted among adolescents

1. The level of physical aggression will be higher among adolescents who are co-using alcohol and tobacco compared to the single users of alcohol and tobacco and abstainers.
2. The prevalence of bullying is higher among co-users than among current smokers or current drinkers and abstainers.
3. The symptoms of ADHD are more severe among co-users compared to the single users of these substances and abstainers.
4. The internalizing symptoms are more significant in the group of co-users of alcohol and tobacco than in the groups of single users of these substances and in the group of non-users.

Hypotheses of the study conducted among young adults

1. In the occurrence and frequency of physically and verbally aggressive behaviors and violent behaviors resulting in problems with the police, there will be a difference in gender and age and among the members of the four investigated groups of drug users.

2. There will be observable differences in the associations among the used chemical substances and externalizing symptoms. It is hypothesized that the use of stimulants (amphetamines, cocaine and tobacco) will be associated to these behaviors.

3. In the occurrence and frequency of anxiety and suicidal ideation there will be a difference in gender and age and among the members of the four investigated groups of drug users. Both anxiety and suicidal ideation will be more severe in the group of outpatient treatment seekers than among participants of mandatory drug treatment programs or among young adults at risk of drug use.

4. There will be observable differences in the associations among the used chemical substances and internalizing symptoms. It is hypothesized that the use of opiates, sedatives, analgesics and tobacco will be associated to these symptoms.

5. Motivation for treatment will be different across sexes, age groups and the severity of substance use problems. There will be differences in the positive and negative aspects of drug use and in general treatment motivation across the four subsamples.

III. METHODS

Methods of the study conducted among adolescents

The presented study was conducted by the Addiction Research Institute as part of the research project titled "Törless/z/ Project" (founded by the National Research and Technological Office. Contract number: OMFB-00703/2009).

Study sample and data collection

In order to investigate these associations among students in the transition period from early adolescence to adolescence, a cross sectional survey was performed in a representative sample of the ninth grade classes of the state-run public secondary schools in Budapest. In the school year of 2009/2010 there were 469 state-run secondary schools in Budapest, with 9^{th} grade classes, out of which we randomly selected 55 schools for inclusion in the study. Thirty-nine of these, with a total of 40 classes comprising 1206 students, agreed to participate. Out of the 1206 students, 944 yielded data for the current investigation.

Data collection with self-report questionnaires was conducted in the classrooms with the permission of the principals of the schools. Data were collected by experienced professionals, who participated in a special training prior to data collection to ensure validity and to reduce biases, which may occur in classroom contexts. Teachers were not present during the data

collection. The administration time was 45 minutes. Approval to the study was granted by the central competent authority supervising research in educational institutions in Hungary. All subjects participated voluntarily and all data were collected anonymously. After being informed of the nature of the study, parents provided written informed consent. Data were collected during the 2009/2010 school year.

Measures

During the analyses presented in this dissertation the following instruments were used:
European Version of the Adolescent Assessment Dialogue (EuroADAD), Drug Use problem area; Buss-Perry Aggression Questionnaire (BPAQ), Physical Aggression (PA) Subscale; Olweus Bullying and Victimization Questionnaire; Reduced Aggression and Victimization Scales; Attention Deficit Hyperactivity Disorder Rating Scale IV; Strengths and Difficulties Questionnaire, (SDQ).

Statistical analyses

For descriptive statistical analyses, we applied analysis of variance (ANOVA) for continuous- and Chi-square test for categorical variables. During hypothesis testing, the associations among physical aggression, bullying, emotional problems, symptoms of ADHD and the concurrent use of alcohol and tobacco were analyzed in two steps. In the first step Generalized Linear Integrated Mixed Model (GLIMMIX; in the case of physical aggression) and Generalized Linear Mixed Model (GLMM; in the case of all other variables) were used. In these models dependent variables were used as continuous variables. Variables of current alcohol drinking and tobacco smoking served as independent variables. The interaction between the main effects of smoking and drinking was also included in the models. Gender was used as a covariate. In the second step of the analyses dependent variables were used as binary categorical variables in the binary logistic regression models. For effect sizes we used the Odds Ratio (OR) statistic.

The Statistical Analysis System (SAS) for Windows (version 9.1; SAS Institute, Cary, NC) and the Statistical Product and Service Solutions (SPSS) for Windows (version 20.0; IBM) were used for all statistical analyses. The (Type I Error) level of 0.05 was adopted to all analyses for statistical significance.

Methods of the study conducted among young adults

This presented study was conducted by the Addiction Research Institute as part of the research project titled "Adaptation of new instruments measuring addictive problems in Hungary".

Study sample and data collection

The study comprised three subsamples of young drug users, differing in the severity of drug use and help-seeking status: 1) Treatment program participants with the highest severity of drug use relative to the other subsamples (N=98, mean age=25.6); 2) Patients in a mandatory drug treatment program due having committed a crime connected to drug use (N=85, mean age=23.5); 3) Young adults at risk of drug use who visited electronic music parties (N=76, mean age=22.9). It should be noted that participants in the mandatory treatment could represent individuals who had only used drugs on one occasion. In addition to the drug user sample a sample of students from college education, matched in age has also been drawn and served as a control group (N=109, mean age=25.5) All subjects in the study were informed about the study purposes and were asked for consent for participation. All subjects participated voluntarily and all data from study participants were collected anonymously. Outpatient treatment program participants: data were collected at two outpatient centers treating drug problems; Mandatory drug treatment program participants: two low-threshold treatment centers offering mandatory drug treatment programs; Young adults at risk of drug use: two electronic music party events; Control sample: subjects were randomly selected from the students of three institutions of college education.

Measures

In the study Drug Use Disorders Identification Test (DUDIT) and Drug Use Disorders Identification Test-Extended (DUDIT-E) were administered.

Statistical analyses

Psychometric evaluation of the instruments included the following: testing Cronbach's alpha coefficients, item-total and inter-item correlations for internal consistency. Temporal

reliability was calculated using intraclass correlation coefficients. Exploratory factor analysis was used in order to explore the factor structure of the instruments. In order to investigate the criterion validity of the instruments, General Linear models were used. Predictive validity was evaluated via sensitivity, specificity and optimal cutoff values based on Receiver Operating Characteristic analyses.

During hypothesis testing analysis of variance (ANOVA) was used in order to test group differences. Multiple linear regression models were used for investigating the associations among the use of specific substances, symptoms of psychopathology and treatment motivation. In all models 12 variables served as explanatory variables: the frequency of use for 10 substances (variables of DUDIT-E D scale: cannabis, amphetamines, cocaine, opiates, hallucinogens, solvents and other drugs, GHB and other designer drugs, sedatives and pain relievers and tobacco) and two demographic control variables (gender and age). In all models, exploratory variables were included using the ENTER method. The Statistical Product and Service Solutions (SPSS) for Windows (version 20.0; IBM) were used for all statistical analyses. The (Type I Error) level of 0.05 was adopted to all analyses for statistical significance.

IV. RESULTS

Results of study conducted among adolescents

Overall 944 pupils participated in the study (overall response rate: 78%). The mean age was 15.03 years (SD=0.77); 48.5% of the respondents were boys. Three hundred and seventy three pupils were attended to secondary grammar schools (39.5%), 410 to trade schools (43.4%) and 161 to vocational schools (17.1%). Half of the students (50.7%) did not use alcohol or tobacco in the last 30 days at least on one occasion. Overall 29.6% (n=279) students smoked at least once in the last month prior to data collection and 41.4% of students drank alcohol at least on one occasion. Based on the co-occurrence of the use of these two substances 7.9% (n=75) of the students can be considered as current smoker and 19.8% as current drinker (n=187). The prevalence of concurrent use was 21.7% (n=204). All investigated psychometric instruments had acceptable psychometric characteristics.

Relationships between smoking and drinking and physical aggression

Results of the primary GLIMMIX analysis, controlled for gender, showed that both drinking and tobacco smoking had a relationship with physical aggression (F=36.54, df=937, p<0.001 (smoking) and F=8.15, df=937, p=0.004 (alcohol). Both current smoking and drinking were associated with higher levels of physical aggression. The interaction between the main effects of smoking and drinking failed to reach statistical significance (F=1.14, df=937, p=0.285). The joint use of these two substances was associated with a numerically higher average on the Physical Aggression subscale compared to the groups of abstainers, current drinkers and current smokers. Thus the highest physical aggression scores were measured in the group of concurrent users (26.43 (SE=0.042) and the lowest values in the group of current abstainers (19.60 (SE=0,016). The mean PA score in the current smokers' group was 25.73 (SE=0,042) points. This result indicates that the association between current smoking and physical aggression was considerably stronger than the association between alcohol and physical aggression (the least square mean difference between smokers and non-smokers is 0.26, while this difference is 0.07 between drinkers and non-drinkers).

In the second step of analyses the dichotomized version of the physical aggression variable was used. Similar to the analysis of the continuous variable, GLIMMIX showed a significant main effect on current smoking (p<0.0001) with no interaction. The main effect of current drinking reached marginal statistical significance (p=0.051). The interaction between the main effects of current drinking and current smoking and the main effect of the gender variable did not reach statistical significance (p>0.05). The estimated Odds Ratio for the occurrence of the high physical aggression among current smokers was 3.63 (CI: 2.55-5.18) (p<0.0001). Regarding current drinking (p=0.051) the OR was 1.42 (CI=0.99-2.02).

Relationships between smoking and drinking and bullying

Results of the primary GLMM analysis controlled for gender indicated that the main effects of smoking and drinking did not reach statistical significance (smoking: F=2.10, df=933, p=0,111; alcohol drinking: F=2,55, df=933, p=0,147) for victimization. The interaction between the main effects of smoking and drinking did not proved to be significant (F=0.29, df=933, p=0,593). Regarding being a perpetrator of bullying, the results of the GLMM analysis showed that both drinking and smoking are associated with bullying (F=11.45, df=933, p=0,001 (smoking) and F=5.43, df=933, p=0,019 (drinking)). Both current smoking and drinking were associated with higher scores of bullying. The interaction between the main effects of drinking and smoking did not reach statistical significance (F=0.41, df=933,

p=0.552). The concurrent use of these substances numerically associated with higher scores on Bullying Scale compared to current drinkers, current smokers and abstainers. The GLMM analysis of the Victimization Scale showed that the main effect of alcohol drinking was associated significantly with higher scores (F=5.52, df=934, p=0.019). Scores for current smokers were lower than the scores for abstainers. The interaction between smoking and drinking did not reach statistical significance. The conducted GLMM analysis for the Aggression Subscale yielded that the main effects of both smoking and drinking were associated to bullying (smoking: F=17.99, df=934, p<0,0001; alcohol drinking: F=18.54, df=934, p<0,0001). Current smoking a current drinking were both associated with higher scores on the Aggression Subscale. The interaction between the main effect of smoking and drinking did not reach the level of statistical significance (F=0.29, df=934, p=0.593).

Relationships between smoking and drinking and the symptoms of ADHD

The GLMM analysis conducted with the ADHD Scale scores as dependent variable (controlled for gender) showed that the main effects of both alcohol drinking and smoking were associated with the ADHD scores (current smoking: F=31.92, df=937, p<0.0001; current drinking: F=8.70, df=937, p=0.003). Both smoking and drinking were associated with higher ADHD scores compared to no use. The interaction between the main effects of smoking and drinking did not reach the level of statistical significance (F=0.452, df=937, p=0.502). Numerically, in the group of concurrent users higher ADHD scores were measured than in the groups of abstainers or single users of tobacco or alcohol. The highest ADHD scores were measured in this group (18.16; SE=0.53).

Relationships between smoking and drinking and internalizing symptoms

Results for the GLMM analysis (controlled for gender) conducted for the Emotional Symptoms Subscale (dependent variable) yielded that the main effects for smoking or drinking did not reach the level of statistical significance. The main effect of smoking was marginally significant (p=0.084). The interaction between the main effects of the two variables was not statistically significant (p=0.833). Nominally, the lowest scores were observable among current drinkers (2,74;SE=0.16) and the highest scores were observable among current smokers (3.17; SE=0.26).

Results of the study conducted among young adults

Ninety eight respondents were in the group of outpatient program participants; 85 in the group of mandatory drug treatment program participants; 76 in the group of young adults at risk of drug use (electronic music party attendants); and 109 in the control group. The whole sample comprised of 368 participants. The subsamples did not differ in mean age. In the groups of mandatory treatment program participants and young adults at risk of drug use the use of cannabis, amphetamines, cocaine, hallucinogens and designer drugs were the most frequently used illegal drugs. In the group of outpatient treatment program participant opiates were the most prevalently used drug. Thinners and inhalants were used dominantly in the group of young adults at risk of drug use. For the DUDIT, Cronbach`s alpha coefficient for the 11 DUDIT items across all four study groups was 0.92.

The alpha coefficient was generally high for each study groups: 0.90 (outpatient treatment program participants), 0.85 (mandatory drug treatment program participants), 0.88 (young adults at risk of drug use), and 0.77 (controls). For the individual DUDIT-E subscales, Cronbach's alpha values for the total sample were acceptable for each subscale (D: 0.83; P: 0.95; N: 0.94, T: 0.90). Intraclass correlation coefficients for DUDIT and DUDIT-E varied between 0.83 and 0.91 across all individual subscales, indicating good test-retest reliability. Lower values occurred for the D and P subscales of the DUDIT-E, but they were still in the acceptable range (0.83 for both subscales). Based on the results of the conducted analyses, the validity of the instruments were acceptable.

H*ypotheses tests*

1. Hypothesis: Significant gender differences were observed in the whole sample. Among males the mean score of the DUDIT-E item measuring verbal and physical aggression was 0.59 (SD=0.91), and among females it was 0.21 (SD=0.66; $p<0.001$, $F=15.154$, $df=360$). Violent behaviors under the influence of drugs resulting in problems with the police scores also showed a significant gender difference (0.58 for males (SD=0.66) and 0.17 for females (SD=0.48; $p<0.001$, $df=359$). Significant differences were observable in age groups for the variable measuring aggression (0.77 in the group aged 25 years or less and 0.61 in the group aged 26 or more; $p=0.02$, $F=5.48$, $df=359$). Significant differences were demonstrated across the study groups. For both variables the highest scores were observed in the group of outpatient treatment seekers. According to the results of the Tukey's post hoc test differences in the mean scores were both variables were significant between the groups of participants of outpatient treatment programs and mandatory treatment programs ($p=0.005$) and between the groups of participants of mandatory treatment program and the control group ($p<0.0001$).

2. Hypothesis: The conducted multiple linear regression model was significant with the item measuring aggression as dependent variable. The included explanatory variables explained 43% of the total variance. The effects of amphetamines, cocaine, opiates, designer drugs, sedatives and analgesics proved to be significant. Among these variables opiates, amphetamines and cocaine had the strongest explanatory power in the model. The second regression model with the variable measuring problems with the police due to violent behaviors under the influence of drugs as dependent variable proved to be significant. The explained proportion was 29% of the total variance. Variables of cannabis, amphetamines, opiates, designer drugs and gender had significant effects. Opiates, designer drugs and gender had the strongest explanatory power.

3. Hypothesis: Among males the mean score of the item measuring anxiety symptoms was 0.67 (SD=0.90) and it was 0.28 among females (SD=0.57; $p<0.001$, $F=17.69$, $df=361$). The mean scores for suicidal ideation was 0.26 among males (SD=0.68) and 0.04 among females (SD=0.20), the difference was significant ($p<0.001$, $F=10.82$, $df=361$). There were no observable differences across age groups. Across study groups differences were significant for both variables. The highest scores were observable in the group of mandatory treatment program participants for anxiety while in the group of outpatient treatment seekers for suicidal ideation.

4. Hypothesis: The conducted multiple linear regression model was significant with the item measuring anxiety as dependent variable, it explained 25% of the variance of the dependent variable. The effects of the following explanatory variables were significant: cannabis, amphetamines, designer drugs, sedatives and hypnotics. The effects of the designer drugs and amphetamines were the strongest. The model containing the variable for suicidal ideation also proved to be significant (with 25% of explained variance). The explanatory power of cannabis, cocaine, opiates and thinners reached the level of statistical significance. The effects of opiates and thinners had the strongest effect.

5. Hypothesis: For P, N and T Scales and for the MotInd statistically significant differences were showed by the implemented ANOVA tests across the study groups. For P Scale the highest mean scores were observable in the group of outpatient treatment seekers, but scores were almost identical among young adults at risk of drug use (24.92 and 24.79). The mean

scores were lower among mandatory drug treatment program participant (20.03). The highest scores were observed in the control group. According to the employed Tukey post-hoc test the differences were only significant among the control group and the three other groups. For N scale the highest mean scores were observable among outpatient treatment seekers (15.46) followed by the participants of mandatory treatment program (10.66), young adults at risk of drug use (9.77) and the control group (1.00). The post-hoc test showed that the difference was significant only among the groups of outpatient treatment seeker and the other three groups. Regarding T Scale the mean scores were the highest in the group of mandatory treatment program participants. For the MotInd, the highest scores were observable in the group of outpatient treatment seekers (2.59) followed by the mandatory program participants (2.01). Scores for the other two groups were significantly lower (0.75 and -0.01 in the groups of young adults at risk and the university students respectively).

V. CONCLUSIONS

Conclusions of the study conducted among adolescents

1.) In the present study the prevalence of concurrent use of alcohol and nicotine was 21.7%, which is in line with the findings prior studies in samples of ninth grader students. The identified prevalence rates for smoking are higher than the European average and are in line with findings of the HBSC and ESPAD in Hungary. Students attended to vocational schools are the most endangered population in this study in terms of getting drunk and the concurrent smoking and alcohol drinking.

2.) Effects of current drinking and smoking occurred additively in the case of physical aggression. This association was observable regardless of the level of measurement (i.e. continuous or dichotomous) for this variable. The comparison of the odds ratios of smoking and drinking highlights the relative importance of current smoking in the development of physical aggression.

3.) School bullying was examined with two approaches of measurement. The use of both instruments yielded similar results. In case of victimization and initiation of bullying were associated with alcohol drinking and the effect of smoking reinforced the effect of alcohol

drinking. These results are highlighting the relative importance of alcohol drinking in connection with bullying. The prevention of alcohol drinking should be a key factor in endeavors addressing bullying prevention or intervention in this age group.

4.) Regarding ADHD symptoms our results are in line with the documented association in the literature: the main effects of both substances showed a statistically significant association with ADHD scores. This association was somewhat stronger for smoking than for drinking. This result corresponds with results of prior studies which attributes a greater role for ADHD in the development of smoking than in the development of drinking. While the interaction of the two substances was not significant, it was observable that ADHD scores were highest in the group of the concurrent users. This result suggests the additive nature of the joint effect of these substances.

5.) In terms of internalizing symptoms it is observable, that scores were higher in the group of abstainers than in the group of alcohol drinkers. This result suggests the self-medicalizing use of alcohol for emotional problems. But this maladaptive self-medicating effort can lead to alcohol use disorders and additional psychiatric disorders on the long run.

6.) Upon these results two patterns of substance use was identified regarding externalizing and internalizing symptoms. Internalizing problems (emotional symptoms and victimization of bullying) are associated with alcohol drinking. In these cases smoking was a complementary element of alcohol consumption. For externalizing symptoms the relative importance of smoking was identified what can be reinforced by alcohol drinking.

Conclusions of the study conducted among young adults

1.) Significant gender differences were identified for the externalizing symptoms. Males reached significantly higher scores than females on both items. This is in line with results of prior studies, which yielded that physical aggression is more characteristic for males than females. Differences across the age groups were demonstrated only in the case of physical and verbal aggression. Aggression was characteristic for younger participants. Despite the fact, that the highest mean age was measured in the group of outpatient treatment seekers, both aggression and problems with the police due to violent behaviors under the influence of drugs scores were significantly higher in this group than in the other three groups. This result

highlights the possibility that these patients suffer from more severe symptoms of psychopathology than the participants in the other three groups. The frequency of drug use yielded predictive power in the cases of opiates, amphetamines and cocaine. In the case of these substances it is well documented in the literature that the use of these drugs is associated with physical aggression and during acute intoxication they can accentuate the occurrence of aggressive behavior.

2.) Gender differences were significant for internalizing symptoms. Males suffered from anxiety and suicidal ideation more frequently than females. In case of suicidal ideation the highest mean scores were observed in the group of outpatient treatment seekers, which can indicate the possibility of the presence of comorbid mood disorders. The fact that, the mean score of suicidal ideation was also elevated among young adults at risk of drug use might reflect to an increased level of vulnerability for mood disorders in that group.

3.) The identified substance use patterns in this sample signifies an elevated risk for young people attending electronic music parties on a regular basis. The implementation of specific harm-reduction programs focusing on the potential dangers associated with substance use in this group would be beneficial. Such program could play an important role in identifying clinically significant symptoms of psychopathology and in suicide prevention. For mandatory drug treatment program participants the reduction of anxious symptoms and the distress induced by the legal procedure should be an important part of these programs.

VI. BIBLIOGRAPHY OF THE CANDIDATE'S PUBLICATIONS

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