Co-occurring mental illnesses and substance use disorders: Evidence from Cyprus

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ABSTRACT

Co-occurrence of substance misuse and mental health conditions is an important problem in the treatment of substance use disorders and mental illnesses. The focus of this paper is to investigate co-occurring disorders with feedback directly to patients on outpatient individual treatment adherence. The study is conducted using data from a randomly selected sample from an outpatient treatment centre of a private psychiatric clinic in Cyprus. Participants are individuals with substance (ab) use disorder and dependence, who had asked for admission and who had been advised to start individual treatment, after a standardized admission assessment with the European Addiction Severity Index (EuropASI). Despite the limitations of this study, the overall results do provide evidence of an association between mental illness and substance abuse. However, it is concluded that more research is needed in order to disentangle the dynamics of this dual relationship.

Introduction

The range of expression of dual diagnoses[1] is remarkably diverse due to the large number of possible combinations of each mental illness with the substance abuse disorders (see Horsfall, Cleary, Hunt, & Walter, 2009, for a thorough discussion). This study is mainly focused on patients with mental illnesses symptoms, including depression, hallucinations, violent bursts, suicidal thoughts; and co-occurring substance use disorders, especially with drugs in common use, such as alcohol and cannabis. The main goal is to contribute to this growing literature by producing evidence of an association between mental illness and substance abuse for Cyprus, a country fast developing as a centre for medical tourism.[2]

The risk of developing mental illness symptoms as a result of substance misuse and vice versa has been the topic of extensive and inconclusive research. Zammit et al. (2008) are amongst many researchers who conducted systematic reviews to look specifically whether substance use (such as cannabis) leads to worse outcomes in people with psychotic disorders (such as schizophrenia). They find that only a few of these studies adjust for factors known to influence mental health outcomes, such as other substances abuse (Jane-Lopis & Matytsina, 2006) and socio-demographic characteristics (Lauronen et al., 2007). Furthermore, they infer that an important limitation of

many related studies is that they fail to distinguish the direction of association between substance misuse and mental illness (Frisher, Crime, Martino, & Croft, 2009). Indeed, although misusing substances is associated with a greater risk of developing mental disorders, there is also evidence of increased substance use following psychosis onset (Gregg, Barrowclough, & Haddock, 2007). This is one of the main reasons that the relationship between substance use and mental health disorders is complex and it is considered difficult to establish a clear pathway between the two. Therefore in the estimations carried out in this study the correlates and consequences of living with dual diagnoses are taken into consideration.

In general, people with mental health and substance use disorders are more likely to be male, have a family history of substance abuse and be younger than their non-substance abusing counterparts, with the possible exception of alcohol abusers (Gregg et al., 2007). Considerable research (e.g. Janssen et al., 2006) documents the negative consequences for those with dual diagnoses, which include increased rates of relapse, distorted perception, suicidal ideation, social exclusion, homelessness, aggression, injury, HIV, hepatitis and other physical conditions. Those patients are especially vulnerable, since their substance disorder may destabilize their illness, exacerbate social alienation and increase their potential for violent outbursts (Green, Drake, Brunette, & Noordsy, 2007). Furthermore, friends and family who live

with, care for, or otherwise remain in contact with people having dual diagnoses will also experience distress, tension and conflict within these relationships (Cleary, Hunt, Matheson, & Walter, 2008).

The present study uses a sample of patients who had been advised to start individual treatment after a standardized admission assessment with the European Addiction Severity Index (EuropASI). Based on literature suggesting: a) an elevated risk developing co-occurring disorder in certain socio-demographic groups, b) a substantial rise in the rates of certain diseases and physical injuries in people having dual diagnoses and c) the strain assumed in the social and family relations of those, the results from this paper account for a corresponding increase in the probability of developing a mental illness when these factors are present.

Similar reports in the literature include Rodríguez-Jiménez et al. (2008), who estimate the prevalence of dual diagnosis in psychiatric inpatients admitted consecutively to a psychiatric hospitalization unit in Spain; Scherbaum, Specka, Schifano, Bombeck, and Marrziniak (2010), who aim at investigating whether attendance of a drug consumption facility in Germany was associated with both reduction of drug-associated at-risk behavior and referral to the health care treatment system; and Charzyńska et al. (2013), who compare the socio-demographic and clinical profile of the inpatients with dual diagnosis in Poland with the profile patients treated in other European centers.

The goal of this study is to contribute to this growing literature by producing evidence of an association between mental illness and substance abuse for Cyprus, a country where co-occurring disorders have not been previously examined. Given the difficulty to establish a relationship between substance use and the development of mental disorders (and also to determine the direction of causation in any such occurred association), in the statistical analysis carried out in this paper both direct and reverse probit regressions are performed.

The organization of this study is as follows: Section 2 describes the data set used, Section 3 provides the statistical framework used in examining the interaction of mental illness with substance misuse, Section 4 presents the estimation results and Section 5 concludes. Additional information is provided in the appendix.

Data

The study is conducted using data randomly selected from the outpatient treatment centre of Veresies Clinic, a private psychiatric agency in Cyprus. Participants ($n = 100$) are individuals with substance use disorders, who had asked for treatment and who have been advised to start individual therapy after a standardized admission assessment with the European Addiction Severity Index (EuropASI). The Addiction Severity Index (ASI) is a relatively brief, semi-structured interview designed to provide important information about aspects of a person's life which may contribute to his/her substance abuse symptoms. It is considered as the first step in developing a patient profile for subsequent use by research and clinical staff.

EuropASI is the primary result of the work a group of European researchers who have as a main goal to develop a uniform Addiction Severity Index (ASI), in order to compare drug and alcohol users across Europe. It came as a consequence of an initiative taken by Christina Hartgens (The Netherlands) and Anna Kokkevi (Greece) at the beginning of 1993. The guide derived from this effort (see Blanken et al., 1996 for a description) it is now considered as an undoubtedly useful tool for studying drug and alcohol users in and out treatment agencies in many different European countries.

Study design

The admission assessment of the Veresies clinic is based upon the European version of the Addiction Severity Index (EuropASI), a semi-structured interview offering an inventory of problems in seven potential problem areas (physical health, education-work-income, alcohol use, drug use, judicial, relations, psycho-emotional). The information from ASI is synthesized on a two-sided feedback form, placing positive aspects of the patient's experience against the problems in each life area. This form helps clinicians to communicate findings from EuropASI with the patient and to suggest and support treatment options.

All persons who entered the specific outpatient drug-treatment centre in this private psychiatric clinic between February 2011 and April 2014 were candidates for inclusion in the study. To be taken in charge for treatment, patients should have been diagnosed for substance abuse or dependence for at least one substance, inclusive single alcohol abuse or dependence. The inclusion criteria for being candidates for the sample of this study were that the patient: (a) gave informed consent about the use of data and being contacted for follow-up, (b) passed the full admission assessment, consisting of at least a first contact session, the EuropASI interview and a feedback session, and (c) was advised to start individual treatment.

Patients' profile

The sample used in the calculations and estimations of this study consists of maximum 100 observations on individuals aged 17 to 58, of both genders and which declared to be employed or unemployed or out of labour force (e.g. soldiers) at the time of the EuropASI admission assessment. An analytical presentation of the sample is provided in Table A.3 of the Appendix. This information is useful in deriving a profile of the individuals participating in the sample and indicates that participants were mainly single male Cypriots with an average age of 32. Most patients lived with their parents or family at the time of their admission and their usual place of residence was in a big urban city (i.e. with population exceeding 100,000). Their education level was low, with less than 65% having finished secondary school (lyceum). About one-third of the participants were full-time employed at the time of their admission, another one-third of them were unemployed and the rest were either part-timers or persons out of labour force (students, soldiers, pensioners, etc.).[3]

Cannabis was the primary substance of abuse in the patients in the sample, followed by cocaine, heroin, hallucinogens and alcohol. As indicated in Table 1, higher problem severity was most frequent in the area of amphetamines abuse, followed by use of heroin, cannabis and cocaine. The primary symptoms of mental illness present in this study were severe depression, intense stress, having trouble concentrating, violent bursts and suicidal thoughts or attempts. As indicated further-on, higher problem severity was most frequent in the case of hallucinations and suicidal incidents. About 7% of the admissions were prompted or suggested by the criminal justice system and more than 90% of the patients were selected for outpatient drug-free treatment programs. Around 16% of the admitted patients were taking prescribed medication on a regular basis for a physical problem at the time of their admission.

Given the trend of Cyprus attracting more foreigners for treatment, an article comparing/contrasting the profiles of those two populations (i.e. Cypriots and foreigners) might yield interesting information related to dual diagnosis in the setting. However, the portion of the foreigners in the sample is quite small and heterogeneous,[4] thus the

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[3] The average age of the Cypriot population in the sample period is around 38 years, the percentage of adult population with a secondary school (lyceum) leaving certificate is 80–81% and the unemployment rate ranges from 7.9% to 16.1% (Statistical Service of Cyprus, 2011, 2012, 2013, and 2014). Therefore, the age, educational level and unemployment rates of the patients included in the sample appear significantly different from the ones of the general population.

[4] The ethnic distribution of the sample is the following: Cyprus: 79, Armenia: 1, Bulgaria: 1, Georgia: 3, Greece: 6, Latvia: 1, Iran: 1, Romania: 2, Russia: 1, Serbia: 1 and South Africa: 2. For two of the patients participating in the sample their EuropASI questionnaires did not contain information about their

Table 1
Evaluations of the patients' need for treatment.

A. Symptoms of substance use disorders	Interviewer's severity rating	Patient's severity rating
A.1 Alcohol abuse	2.8	2.5
A.2 Heroin use	3.6	3.0
A.3. Medicine/pills use (#)	4.0	3.2
A.4. Cocaine use	3.2	2.9
A.5 Amphetamines use (#)	4.0	3.0
A.6 Cannabis use	3.2	2.8
A.7 Hallucinogens use	3.8	3.9
A.8 Injections use	3.6	3.0
B. Symptoms of mental illness	Interviewer's severity rating	Patient's severity rating
B.1 Experienced severe depression	2.5	2.9
B.2 Experienced serious anxiety or tension	2.3	2.7
B.3 Experienced trouble understanding, concentrating, etc.	2.8	3.1
B.4 Experienced hallucinations	3.6	3.2
B.5 Experienced trouble controlling violent behaviour	2.8	2.9
B.6 Been prescribed medication for any psychological problem	2.8	3.3
B.7 Experienced serious thoughts of suicide	3.1	3.2
B.8 Attempted suicides	3.1	3.4

Notes: Table 1 presents the average (mean) evaluation of the patient's need for professional treatment, separately in the presence of each particular symptom. In the second column the severity of the patient's need is evaluated by the interviewer (based on his/her observations) while in the third column the evaluation is made from the patient him/herself. The symptoms are classified and measured according to EuropASI (see Blanken et al., 1994). In both evaluations a severity scale of 0 to 4 is used. Hash tag (#) indicates symptoms where less than 10 cases were recorded (less than one tenth of the whole sample).

current data set is insufficient to perform an analysis in the manner of Charzyńska et al. (2013).

Variables of interest

The aforementioned EuropASI questionnaire assigns the information about the patient in nine broad categories: A. Basic Information, B. General Information, C. Medical Status, D. Employment/Support Status, E. Drug/Alcohol Use, F. Legal Status, G. Family History, H. Family/Social Relationships and I. Psychiatric Status. Given the scope of this paper, the information of main interest is the interviewers' rating of the patients' need for treatment for alcohol and drug problems (Group E) and the interviewer's rating of the patients' need for psychiatric treatment (Group I). The rest of the information collected in the EuropASI assessment sessions was utilized in the statistical analysis carried out in the subsequent sections according to their relativity with the goal of the paper and the number of observations for which they were available. As indicated in Table A.3 of the Appendix, there were missing observations, since not all questions in the questionnaire were answered by all the patients.

Table 1 summarizes the participants' need for psychiatric treatment. According to EuropASI guidelines, the severity of each patient's case is evaluated on a scale 0–4, where 0 indicates a person who does not warrant treatment at all, and 4 is assigned to a person which is in an extreme need for treatment. The severity ratings in this sample are presented in the second column of Table 1, where their average value is calculated separately for each particular abuse or mental disorder symptom. In plain terms, Table 1 shows the average evaluation for the need of treatment separately for each group of patients indicating a specific symptom (e.g. 'alcohol abuse' or 'severe depression'). The calculations are carried out using STATA for Windows (release 12.0).

The calculations presented in the upper panel of Table 1 suggest that the substance misuse symptom associated with the higher rating of treatment need in the sample of this study is 'use of non-prescription pills' (average rating 4.0) and the symptom associated with the lowest severity rating is 'alcohol abuse' (average rating 2.8). In the case of the mental disorder symptoms variables (lower panel of Table 1), the symptom associated with the highest necessity for treatment is 'patient experienced hallucinations' (average rating 3.6) and the symptom

associated with the lowest severity of treatment is the 'patient experienced severe anxiety or tension' (average rating 2.3).

A comparison of the calculations in the second column (interviewers' ratings) with the ones in the third column (patients' ratings) reveals that in the cases of substance use disorders, the patients tend to underestimate their need for treatment (i.e. they do not believe they are as sick as the interviewer assesses). Contrary, in the cases of mental disorders the patients tend to overestimate the need for treatment for their symptoms (i.e. they believe they are more unwell than the interviewer thinks they are). The notable exception in both cases is the symptoms associated with hallucinations (using hallucinogens and experiencing hallucinations).

Correlations

As a first step in examining the existence of an association between substance disorders and the development of mental illnesses, in this paper the correlations of the substance misuse variables with the mental disorder symptoms variables are calculated. The calculations are performed using STATA for Windows (release 12.0) and are presented in Table 2.

Focusing on estimates which in absolute value are equal to or higher than 20%, the calculations in Table 2 suggest that use of heroin is highly correlated with problems in concentrating and apprehending (20%) and that alcohol abuse is negatively correlated with severe anxiety (-21%). It is also suggested that taking pills with no doctors' prescription is highly correlated with the patients having suicidal thoughts and attempts (20% and 24%, accordingly).[5] There is also evidence for high frequency of suicide attempts in patients using or having used injections (23%).

The correlations of those symptoms with the evaluation of the patient's need for treatment are also calculated. In the last column of Table 2 it is suggested that taking pills with no doctors' prescription is highly correlated with a need for psychiatric treatment (23%) and in the last two rows of the Table it is suggested that having tendencies for suicide is associated with a need for alcohol abuse treatment (23% and

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[5] The calculations involving patients using pills and amphetamines should be viewed with precaution, since there were less than 10 such cases in the sample. Because of the insufficient number of observations, the empirical results reported in the subsequent sections do not include the estimations for pills and amphetamines users (as well as for other four cases, as explained later on).

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(footnote continued)
nationality.

Table 2
Correlations between substance misuse and mental illness symptoms.

	Depr.	Stres.	Conc.	Hall.	Viol.	Meds	Suic.	Atte.	Psych. rating
Alcohol	(0.12)	(0.21)	(0.08)	0.02	0.04	(0.05)	0.04	(0.01)	0.01
Heroin	0.08	0.08	0.20	0.01	(0.06)	0.05	0.10	0.10	0.09
Pills (#)	0.11	0.09	0.07	0.00	0.08	0.04	0.20	0.24	0.23
Cocaine	(0.06)	(0.07)	0.07	0.07	0.09	(0.09)	(0.09)	0.00	(0.06)
Amp. (#)	(0.14)	(0.15)	(0.08)	0.02	0.07	(0.03)	0.06	0.03	(0.11)
Cannabis	0.03	0.02	(0.11)	0.06	0.01	(0.11)	(0.15)	(0.08)	(0.01)
Hallucin.	(0.09)	(0.07)	0.03	(0.04)	0.05	(0.03)	0.04	0.05	(0.05)
Injections	0.06	0.11	0.13	0.03	(0.03)	0.04	0.12	0.23	0.08
Alcohol rating	0.13	0.08	0.10	0.08	0.15	0.12	0.23	0.26	0.05
Drug rating	(0.09)	(0.07)	0.12	0.08	0.06	(0.05)	0.10	(0.01)	0.15

Notes: Table 2 presents the correlation of each symptom of mental illness (horizontal classification) with each symptom of substance use disorder (vertical classification). The last column presents the correlations of the severity of the patient's need for psychiatric treatment with each symptom of substance abuse. In the same manner, the last two rows report the correlations of the severity of the patient's need for alcohol and drug dependence issues with each symptom of mental disorder, separately. Parentheses indicate a negative correlation. Hash tag (#) indicates symptoms where less than 10 cases were recorded (less than one tenth of the whole sample).

26%). The correlations of a patient needing psychological treatment with the same patient also needing treatment for alcohol and drug misuse are calculated as 5% and 15%, respectively, which seems a bit low.

In the following sections these implied relationships between substances use and the development of mental disorders are examined with a thorough statistical methodology.

Method

The study utilizes the probit regression framework introduced by Bliss (1934, 1938) to investigate the association between cases of mental illness and substance abuse. These models allow estimating the impact of any specific factor on the probability that a person develops a specific medical condition (e.g. the impact of higher education on the probability of developing a stress disorder). In order for the analysis to be statistically adequate, the models include a number of other covariates suggested in the related literature, such as socio-demographic characteristics (Lauronen et al., 2007; Zammit et al., 2008), other medical conditions (Janssen et al., 2006) and family conflicts (Cleary et al., 2008).[6] In order to test the influences of those factors (covariates) on the variables of interest (i.e. the probability of indicating a substance misuse or a mental illness symptom) the samples z-scores are used. A *p*-value of 0.05 or less is considered to indicate statistical significance. All estimations are performed using STATA for Windows.

Substance misuse equations

In order to evaluate the association of mental disorder symptoms with the occurrence of substance use disorders, probit regressions are estimated, where the dependent variable is an indicator taking the value 1 if the patient has a substance misuse symptom (e.g. alcohol abuse) and 0 otherwise. The covariates include the factors mentioned above (socio-demographic characteristics of the specific patient, other medical conditions, and degree of family conflict; taken from the

EuropASI) and, most importantly, the interviewer's evaluation of the patient's need of treatment for psychological problems. If mental disorders are associated with substance misuse, then the coefficient of the interviewer's evaluation of the patient's need of treatment for psychological problems is expected to be positive and statistically significant.

If the data set used in the current study included information on the time that the patient was first diagnosed with a substance use disorder, as well as on the timing of his or hers first evaluation of need for psychological treatment, then the probit models would not only allow testing the existence of an association between substance use and mental health disorders, but also the identification of the direction of causality in any such relationship. However, the cross-sectional design of this study is considered insufficient to answer such a difficult problem.[7]

Mental disorder equations

Given the difficulty to determine the direction of causality in cases of comorbid conditions, the association of mental disorder symptoms with the occurrence of substance use disorders is also examined with reverse regression models,[8] i.e. where the dependent variable in this case is an indicator taking value 1 if the patient indicates a mental illness symptom (e.g. severe depression) and 0 otherwise. The covariates now include the interviewer's evaluation of the patient's need of treatment for substance abuse problems (instead of patient's need of treatment for psychological problems) as well as all the other covariates mentioned above (socio-demographic characteristics, other physical conditions and family conflicts). Similarly with the substance misuse equations, if substance use disorders are associated with the occurrence of mental disorders, then the coefficient of the interviewer's evaluation of the need of treatment for substance abuse problems is expected to be positive and statistically significant.

Statistical concerns

Since this study examines the relationship between two variables (substance misuse and mental illness) which are most likely to be co-determined, estimates derived may suffer from what in statistics is referred to as 'simultaneity bias'. To circumvent the issue, the estimations

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[6] However, not all information contained in the EuropASI questionnaires could be added in the analysis. If the probit models of this study included all the variables listed in Table A.3, then the estimations carried out would not have substantial degrees of freedom. Therefore, the covariates included had to be carefully selected. Their choice was carried out by performing stepwise regressions. A forward selection approach was used, starting with models including only socio-demographic variables, and then testing the addition of each candidate covariate, using the Bayesian information criterion and the pseudo R-squared as selection criteria. In this aspect this study is similar to Slesnick and Prestopnik (2005), who used stepwise regressions to examine family and individual correlates of dual diagnosis.

[7] Lu et al. (2017) justify using econometric tests of Granger non-causality in cross-sectional data, under certain conditional exogeneity assumptions. However, the methods for testing those assumptions are computationally challenging (see e.g., White & Lu, 2010) and they extend beyond the scope of this study.

[8] Conducting both direct and reverse regressions is a common practice where the examined association bears an unknown direction of causality.

carried out in the following sections use the ratings of treatment need severity from the *patients*' point of view, rather than of the corresponding *interviewers*' evaluations. In other words, the patients' evaluations for the severity of their case are used as instruments for the interviewers' severity indices, in order to account for the potential simultaneity problem. The use of patients' ratings also circumvents the bias inherent in the estimation of reverse regressions.

A second statistical concern in this study is that it lacks a control group to be used as a baseline of comparison and to assess the effects of specific interventions. However, this issue is resolved with the use of dummy (indicator) variables. In order to avoid the dummy variable trap, one of the dummies incorporated for any specific characteristic (e.g. age of patients) has to be removed from the regression, with the omitted category (e.g. patients aged between 17 and 25 years) taken as the base group category, i.e., the group against which the comparisons are made and the estimations are interpreted.

Results

The first step in estimating the equations defined in the previous section is to examine the profiles of the patients exhibiting substance misuse or mental illness symptoms.[9] This kind of information is summarized in Tables A.1 and A.2 in the Appendix.[10] Table A.1 suggests that substance abusers are mainly single male Cypriots with an average age of 32. About 23% of the patients are married and 26% have financial dependants. Their schooling degree is high, with about 70% having finished secondary school (lyceum) and 23% of them having also attended college. About 43% of the participants were either part-time or full-time employed at the time of their admission and 32% were unemployed. The average value of the mental illness severity index in the substance abusers is just above 2.0.

Table A.2 indicates that patients displaying mental disorder issues are mainly single male Cypriots with an average age of 33. About 22% of the patients are married and 25% have financial dependants. Their schooling degree is high, with more than 68% having finished lyceum and 22% of them having attended or finished college. About 40% of the participants were either part-time or full-time employed at the time of their admission and 32% were unemployed. The average values of the alcohol and drug abuse severity indices in the patients experiencing mental illness symptoms are 1.1 and 3.1, respectively. In the following sections the empirical findings are presented.

Substance misuse equations

Table 3 reports the estimates (marginal effects) from the substance misuse equations. In other words, it contains the estimated impacts of socio-demographic characteristics on the probability of developing substance abuse symptoms; and the estimated associations of the mental severity index with the occurrence of substance misuse disorders. A positive estimate indicates that the specific factor *increases* the probability of substance misuse and a negative value indicates that the specific characteristic *reduces* the probability of substance abuse.

The estimates in Table 3 imply that being a woman is associated with a lower probability of substance misuse, but only in the case of heroin users. The nationality has also a role to play, since being a

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[9] Table 2 reports calculations for sixteen cases of substance abuse or mental disorder symptoms. However, for six of those symptoms (namely, pills use, amphetamines use, cocaine addiction, hallucinations, violent behavior and prescribed medication for psychological problems) the probit models performed poorly in terms of statistically adequacy. Therefore, Tables 3 and 4 only report results for the remaining ten probit models, five in each group.

[10] Tables A.1 and A.2 provide means of basic control variables (i.e. patient profiles) for *each* mental illness or substance misuse symptom. The information provided in the text are the means of basic control variables (i.e. characteristics) for the patients exhibiting *any* mental illness or substance misuse symptom.

foreigner (i.e. not a Cypriot) is associated with higher chance of smoking cannabis and a lower chance of using heroin and injections. Alcohol abusers are most likely to be in the ages 40–49, while heroin use is more severe for the ages 25–39. Hallucinogens and injections users are more likely to be 30–39 years old. The probability of being a cannabis user is much less after a person crosses the age of 40.

The probability of using cannabis is also substantially higher if the person is a secondary school graduate and unemployed. Contrary, in the case of hallucinogens, the user is most probably a college graduate and only part-time employed (or out of labour force). The area of residence is statistically significant only in the case of heroin, where there is a higher chance of becoming a user for those living in a medium size town (i.e. where the population is between 10,000 and 100,000). Persons facing legal problems are more likely to be heroin and injection users than those who don't. The existence of family conflicts is also indicated to increase the probability of using heroin.

As far as the variable of interest (mental illness severity index) is concerned, the need of psychiatric treatment has a statistically significant association with the occurrence of a substance misuse disorder only in the cases of cannabis users (where it is implied that mental wellness is associated with less cannabis use) and the case of persons taking injections (where a higher value of the mental illness severity index is associated with higher chance of using injections). The findings thus partly confirm the calculations in Table 2, where there is high correlation between injections use and the mental illness severity index.

Summarizing the results, no statistically significant association of the mental illness symptoms was found with substance-abuse cases, except for use of cannabis and injections (in line with Gregg et al., 2007). Specifically, an increase in the mental illness severity index by one unit is associated with an increase in the occurrence of cannabis use by 0.474% and with an increase in the probability the patient is using injections by 0.218%.

Mental illness equations

Table 4 reports the estimates of the impacts of various covariates factors on the probability of developing mental disorder symptoms and the association of the substance misuse severity indices with the occurrence of mental disorders. A positive estimate indicates that the specific factor is associated with an *increase* in the probability of a patient indicating symptoms of mental disorder and a negative number indicates that the specific characteristic is associated with a *decrease* in the probability of developing mental conditions.

The estimates in Table 4 imply that women have higher chances of falling into severe depression or experiencing anxiety attacks than men. Persons suffering from anxiety are most likely to be in the ages between 35 and 39. Cypriots seem to have lower chances of considering ending their lives than foreigners do. Having financial dependants appears to decrease the probability of experiencing severe stress, while having attended university seems to increase it. Persons out of labour force (such as students, soldiers, pensioners and disabled persons) are the ones most likely to have lack of concentration issues and the ones least likely to suffer from severe depression or stress. There is also a lower chance of having suicide thoughts when living in a big urban centre (i.e. a city).

Persons facing legal problems are more likely to be heroin and injection users than those who don't have troubles with the law. Persons with severe medical conditions are more likely to have stress, while the existence of family conflicts increases the probability of severe depression, lack of concentration and suicidal behaviors. Having a problem related to alcohol abuse has a statistically significant association with the patient thinking about committing suicide or even attempting to do it. The result that increased drug abuse seems to be negatively associated with depression and anxiety is a little perplexing.

Summarizing the findings from Table 4, statistically significant associations of substance abuse were found in all examined mental illness

Table 3
Estimations from substance misuse models.

Variable	Alcohol	Heroin	Cannabis	Hallucin.	Injections
Mental Ill. Severity index:	−0.088	0.067	−0.474***	−0.077	0.218***
A. Socio-demographic characteristics					
Gender:					
Female	−0.109	3.413***	−1.738	−0.420	0.672
Nationality:					
Cypriot	0.257	−1.661***	3.468***	1.191	−1.521***
Age group:					
25–29	0.121	3.367***	−0.958		1.238
30–39	1.308	3.272***	−0.586	1.183***	1.510***
40–49	3.588***	2.694***	−7.030***	1.634	1.089
50–59	1.784	3.501	−6.323***		1.564
Family status:					
Married	0.067	−0.485	2.093	−0.560	−0.749
Has dependants	0.211	0.405	−0.295	2.397***	0.468
Education level:					
High school	0.211	0.095	2.778		
Lyceum	−1.335	−0.200	3.256***	0.406	−0.739
University	−0.048	−0.123	2.031	1.522***	−0.061
Employment status:					
Out of labour force	−0.048	0.605	−2.057***	1.294***	0.252
Part-time	0.856	0.152	−5.783***	1.842***	−0.249
Full-time	−0.157	−0.508	−6.012***	−0.396	−0.607
Area of residence:					
Town	−1.47	1.201***	−0.593	1.189	0.785
City	−0.472	0.911	−2.270	−1.045	0.615
B. Additional influencing factors					
Medical problems index:	−1.295	0.007	0.447	−0.346	0.085
Legal problems index:	−1.122	0.320***	0.210	−0.163	0.240***
Family problems index:	−0.359	0.278***	−0.070	0.040	0.039
Intercept	−0.193	−3.434***	3.347	−5.082***	−1.424
Number of observations	81	81	80	77	78
Pseudo R-squared	0.457	0.416	0.636	0.461	0.318

Notes: Table 3 presents marginal effects estimated from Probit regressions of equations specified for the substance misuse patient groups identified by column. A positive estimate indicates an increase in the probability a patient is misusing the particular substance. (***) denotes significance at 5% and below.

symptoms, except for patients with lack of concentration issues. Specifically, an increase in the alcohol abuse severity index by one unit is associated with an increase in the probability a patient has thought to commit suicide by 0.258% and the probability that a patient has actually attempted suicide by 0.363%. The findings, thus, partly confirm the calculations in Table 2, where there is high correlation between suicidal thoughts and actions and the alcohol abuse severity index. As far as other substance misuse is concerned, an increase in the drug abuse severity index by one unit is associated with a decrease in the probability the patient is depressed by 0.243% and the probability of severe stress by 0.286%.

Discussion

Recent reviews conclude that substance misuse increases risk of mental health disorders and vice versa. This study examines the relationship between substance abuse and mental illness. More specifically, it investigates whether the Cypriot data provide evidence of an association between symptoms of substance abuse and mental disorder. Analysis was conducted for a random sample of 100 patients treated in a private psychiatric clinic in Larnaca, selected via EuropASI.

Limitations of the study

This study has several limitations. First, the sample is not large enough as this paper to be considered as a nationally representative survey of patients in Cyprus. Second, the study focuses on the substance abuse and mental illness symptoms for which there were available observations, thus ignoring the remaining combinations that would be present in a larger or a nationally representative sample. Omitting

variables with high explanatory power from the analysis may alter the findings substantively or in terms of significance levels. Nonetheless, the derived empirical results do not lack in statistical ground and are not indicated imperfect (as indicated by the relatively high values of the pseudo R-squares). Third, the main variables' indexing, i.e. the severity of substance misuse and mental disorder conditions, is not ideal, since there is a simultaneity concern. However, appropriate instruments were chosen and this problem was circumvented. Fourth, the data set does not include a control/baseline group, but this is overcome with the use of dummy variables in the probit models.

Implication of findings

The most parsimonious explanation of the results of this study is that the theories linking substance misuse with mental illness are only partly supported by the findings: Mental illness severity seems to be associated with cannabis and injections use, alcohol abuse severity seems to be associated with suicidal incidents and drug use seems to be associated with a moderation of depression and anxiety disorders.

The first two cases of associations are in line with the reported results from the related literature and therefore the Cyprus inpatients do not appear different in that aspect from any other populations where the co-occurring disorders have been examined so far. However, drug use being associated with moderating depression and anxiety is a little perplexing. How is Cyprus different from other populations which used the same instrument? This result may be due to the absence of a confounding variable from the sample that positively affects drug use, but negatively affects depression and anxiety. This unspecified confounder may be a special cultural feature of Cypriot people that affects their dual diagnosis attributes and could be the subject of future research.

Table 4
Estimations from mental disorder models.

Variable	Depression	Stress	Lack of concentr.	Suicidal thoughts	Suicide attempts
Alc. Use severity index:	0.001	−0.006	0.069	0.246***	0.363***
Drug use severity index:	−0.243***	−0.286***	0.077	0.056	0.031
Socio-demographic characteristics:					
Gender:					
Female	1.687***	2.248***	0.242	0.552	−0.096
Nationality:					
Cypriot	0.256	0.655	0.118	−0.907***	−0.758
Age:					
25–29	0.516	1.030***	0.691	0.151	0.347
30–39	0.810	1.092***	0.533	0.079	0.040
40–49	0.636	0.052	0.639	0.712	−0.273
50–59	1.260	2.403	1.864	0.818	1.051
Family status:					
Married	−0.296	0.566	−0.103	−0.151	−0.117
Has dependants	−0.284	−1.051***	0.386	−0.702	−0.152
Education level:					
High school	−0.007		0.422	−0.134	−1.321
Lyceum	0.241	−0.058	0.821	−0.169	0.534
University	0.548	1.003***	−0.099	−0.801	−1.591
Employment status:					
Out of labour force	−1.084***	−1.027***	0.822***	0.590	1.145
Part-time	−0.793	−0.228	0.594	0.323	0.568
Full-time	−0.705	0.314	0.366	0.324	0.616
Area of residence:					
Town	0.932	0.647	0.109	0.205	0.019
City	0.287	−0.198	−0.411	0.576	−0.382
B. Additional influencing factors					
Medical problems index:	0.328	0.586***	0.214	0.128	0.174
Legal problems index:	−0.294	0.047	0.038	−0.265	−0.144
Family problems index:	0.273***	0.184	0.228***	0.287***	0.284***
Intercept	−0.154	−0.640	−2.462	0.135	−0.787
Number of observations	81	81	81	81	81
Pseudo R-squared	0.278	0.303	0.211	0.255	0.309

Notes: Table 4 presents marginal effects estimated from Probit regressions of equations specified for the mental disorder patient groups identified by column. A positive estimate indicates an increase in the probability a patient is indicating the particular symptom. (***) denotes significance at 5% and below.

Suggestions for future research

Therefore, despite the limitations listed above, the overall results of this study do reinforce the evidence of an association between mental illness and substance abuse symptoms. However, it is concluded that more empirical analysis is needed in order to disentangle the relationship between mental illness and substance abuse and derive more robust empirical results. The application of probit models on panel instead of cross-sectional data sets may even advance the literature by examining not only association but also causation in cases of comorbid conditions.

The findings of this paper, despite the study limitations, are encouraging in the sense that they do provide helpful information on the subject. Therefore, it is suggested that research aiming to examine the topic of dual diagnosis might be made more powerful by using samples derived from EuropASI questionnaires. Possible extensions of this research would be the data set to be exploited in a novel hypothesis-driven way with collaboration with similar EuropASI-based data sets in various countries, in order to examine the implications of the dynamics of the co-occurring disorders to psychiatric nursing and the provision of care.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apnu.2018.11.004.

References

Blanken, P., Hendriks, V., Pozzi, G., Tempesta, E., Hartgers, C., Koeter, M., ... Uchtenhagen, A. (1994). European addiction severity index EuropASI. *Guide for training and administering the EuropASI interview*. European Commission: COST-A6 Working Group 4.
Blanken, P., Hendriks, V., Pozzi, G., Tempesta, E., Hartgers, C., Koeter, M., ... Kokkevi, A. (1996). European addiction severity index EuropASI. *Guide for training and*

administering the EuropASI interview. European Commission: COST-A6 Working Group 4.

Bliss, C. I. (1934). The method of probits. *Science, 79*, 38–39.

Bliss, C. I. (1938). The determination of the dosage-mortality curve from small numbers. *Quarterly Journal of Pharmacology, 11*, 192–216.

Charzyńska, K., Sawicka, M., Osuchowska, A., Chadzyńska, M., Giguere, M., Kasperek-Zimowska, B., & Bronowski, P. (2013). Socio-demographic and clinical profile of patients with dual diagnosis living in Warsaw district Mokotow in comparison with participants in other European countries. *Psychiatria Polska, 47*(6), 989–1000.

Cleary, M., Hunt, G. E., Matheson, S., & Walter, G. (2008). The association between substance use and the needs of patients with psychiatric disorder, levels of anxiety, and care giving burden. *Archives of Psychiatric Nursing, 22*, 375–385.

Frisher, M., Crime, I., Martino, O., & Croft, P. (2009). Assessing the impact of cannabis use on trends in diagnosed schizophrenia in the United Kingdom from 1996 to 2005. *Schizophrenia Research, 113*(2–3), 123–128.

Green, A. I., Drake, R. E., Brunette, M. F., & Noordsy, D. L. (2007). Schizophrenia and co-occurring substance use disorder. *American Journal of Psychiatry, 164*, 402–408.

Gregg, L., Barrowclough, C., & Haddock, G. (2007). Reasons for increased substance use in psychosis. *Clinical Psychology Review, 27*, 494–510.

Horsfall, J., Cleary, M., Hunt, G. E., & Walter, G. (2009). Psychosocial treatments for people with co-occurring severe mental illnesses and substance use disorders (dual diagnosis): A review of empirical illness. *Harvard Review of Psychiatry, 17*(1), 24–34.

Jane-Lopis, E., & Matytsina, I. (2006). Mental health and alcohol, drugs and tobacco: A review of the comorbidity between mental disorders and the use of alcohol, tobacco and illicit drugs. *Drug and Alcohol Review, 25*, 513–536.

Janssen, B., Gaebel, W., Haerter, M., Komaharadi, F., Lindel, B., & Weinmann, S. (2006). Evaluation of factors influencing medication compliance in inpatient treatment of psychotic disorders. *Psychopharmacology, 187*, 229–236.

Lauronen, E., Miettunen, J., Veijola, J., Karhu, M., Jones, P. B., & Isohanni, M. (2007). Outcome and its predictors in schizophrenia within the northern Finland 1966 birth cohort. *European Psychiatry, 22*, 129–136.

Lu, X., Su, L., & White, H. (2017). Granger causality and structural causality in cross-section and panel data. *Econometric Theory, 33*, 263–291.

Rodríguez-Jiménez, R., Aragüés, M., Jiménez-Arriero, M. A., Ponce, G., Muñoz, A., Bagney, A., ... Palomo, T. (2008). Dual diagnosis in psychiatric inpatients: Prevalence and general characteristics. *Investigación Clínica, 49*(2), 195–205.

Scherbaum, N., Specka, M., Schifano, F., Bombeck, J., & Marrziniak, B. (2010). Longitudinal observation of a sample of German drug consumption facility clients. *Substance Use & Misuse, 45*(1–2), 176–189. https://doi.org/10.3109/10826080902873044.

Slesnick, N., & Prestopnik, J. (2005). Dual and multiple diagnosis among substance using runaway youth. *The American Journal of Drug and Alcohol Abuse, 31*(1), 179–201. https://doi.org/10.1081/ADA-200047916.

Statistical Service of Cyprus (2011, 2012, 2013 and 2014), Statistical abstract, Nicosia: Printing Office of the Republic of Cyprus.

White, H., & Lu, X. (2010). Granger causality and dynamic structural systems. *Journal of Financial Econometrics, 8*(2), 193–243.

Zammit, S., Moore, T. H. M., Lingford-Hughes, A., Barnes, T. R. E., Jones, P. B., Burke, M., & Lewis, G. (2008). Effects of cannabis use on outcomes of psychotic disorders: Systematic review. *Journal of Psychiatry, 193*, 357–363.

Zavrou, M. (2015). Medical tourism and wellness treatment in Cyprus. *KPMG White Paper* (Date: 19-01-2015).