

## Present and lifetime comorbidity of tobacco, alcohol and drug use in eating disorders: A European multicenter study

Isabel Krug<sup>a,b</sup>, Janet Treasure<sup>c,d,e</sup>, Marija Anderluh<sup>f</sup>, Laura Bellodi<sup>g</sup>, Elena Cellini<sup>h</sup>, Milena di Bernardo<sup>h</sup>, Roser Granero<sup>i</sup>, Andreas Karwautz<sup>j</sup>, Benedetta Nacmias<sup>h</sup>, Eva Penelo<sup>i</sup>, Valdo Ricca<sup>h</sup>, Sandro Sorbi<sup>h</sup>, Kate Tchanturia<sup>c,d,e</sup>, Gudrun Wagner<sup>j</sup>, David Collier<sup>c,d,e</sup>, Fernando Fernández-Aranda<sup>a,b,\*</sup>

<sup>a</sup> Department of Psychiatry, Bellvitge University Hospital, Barcelona and Ciber Fisiopatología de la Obesidad y Nutrición (CIBERObn), Instituto Salud Carlos III, Spain

<sup>b</sup> Department of Psychiatry, University Hospital of Bellvitge, c/Feixa Llarga s/n, 08907 Barcelona, Spain

<sup>c</sup> Eating Disorders Unit and SGDP Research Centre, Institute of Psychiatry, London, UK

<sup>d</sup> Department of Psychiatry, 5th floor, Thomas Guy House, Guy's Hospital, London SE1 9RT, UK

<sup>e</sup> South London and Maudsley Eating Disorders, IOP/King's College, London SE 58AF, UK

<sup>f</sup> University Children's Hospital, University Medical Centre Ljubljana, Vrazov trg 1, 1000 Ljubljana, Slovenia

<sup>g</sup> Department of Neuropsychiatric Sciences (DSNP), Fondazione Centro S. Raffaele del Monte Tabor, Via Olgettina 60, 20132 Milan, Italy

<sup>h</sup> Department of Neurology and Psychiatric Sciences, University of Florence, Viale Morgagni 85I-50134, Florence, Italy

<sup>i</sup> Departament de Psicobiologia i Metodologia, Universitat Autònoma de Barcelona, Facultat de Psicologia, Edifici B (Campus Bellaterra), 08193 Bellaterra (Cerdanyola del Valles), Spain

<sup>j</sup> Medical University of Vienna, Department of Child and Adolescent Psychiatry, Währinger Gürtel 18-20, 1090 Vienna, Austria

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### Abstract

**Objectives:** To assess the differences in comorbid lifetime and current substance use (tobacco, alcohol and drug use) between eating disorder (ED) patients and healthy controls in five different European countries.

**Method:** A total of 1664 participants took part in the present study. ED cases ( $n = 879$ ) were referred to specialized ED units in five European countries. The ED cases were compared to a balanced control group of 785 healthy individuals.

**Assessment:** Participants completed the Substance Use Subscale of the Cross Cultural (Environmental) Questionnaire (CCQ), a measure of lifetime tobacco, alcohol and drug use. In the control group, also the GHQ-28, the SCID-I interview and the EAT-26 were used.

**Results:** ED patients had higher lifetime and current tobacco and general drug use. The only non-significant result was obtained for lifetime and current alcohol use. Significant differences across ED subdiagnoses and controls also emerged, with BN and AN-BP generally presenting the highest and AN-R and controls the lowest rates. The only exception was detected for alcohol use where EDNOS demonstrated the highest values. Only a few cultural differences between countries emerged.

**Conclusions:** With the exception of alcohol consumption, tobacco and drug use appear to be more prevalent in ED patients than healthy controls. The differential risk observed in patients with bulimic features might be related to differences in temperament or might be the result of increased sensitivity to reward.

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**Keywords:** Eating disorders; Tobacco use; Alcohol use; Drug use; Cultural differences

### 1. Introduction

During the last two decades, a body of research has indicated that substance use problems are common among women with eating disorders (EDs) (e.g. (Bulik et al., 2004; Fernandez-Aranda et al., 2008; Karwautz et al., 2001, 2002;

\* Corresponding author at: Department of Psychiatry, University Hospital of Bellvitge, c/Feixa Llarga s/n, 08907 Barcelona, Spain. Tel.: +34 93 2607922; fax: +34 93 2607658.

E-mail address: [ffernandez@csub.scs.es](mailto:ffernandez@csub.scs.es) (F. Fernández-Aranda).

Thompson-Brenner et al., 2008). In 1994 a review conducted by Holderness and collaborators evaluated 51 studies and revealed that up to 10% of women with the restricting subtype of AN and 41% with BN suffered from co-occurring substance use disorders (Holderness et al., 1994). The prevalence of substance use in eating disordered individuals has however been found to vary considerably across studies, which could be attributable to the fact that researchers have commonly treated substances as one homogenous group. Only more recently have investigations looked at a variety of licit and illicit substances separately (Anzengruber et al., 2006; Bulik et al., 2004; Gadalla and Piran, 2007a; Piran and Gadalla, 2007). The present study adds to the existing literature by assessing tobacco, alcohol and drug use in a large case–control sample across various ED subtypes in several European countries.

### 1.1. Tobacco and eating disorders

In relation to tobacco use prevalence estimates for ED patients have been found to vary between 58.1% and 68.1% (Anzengruber et al., 2006). Given the well-known effects of smoking on weight and appetite, it is not surprising that this behaviour is often utilized as a weight control method in patients with EDs (Austin and Gortmaker, 2001; Croll et al., 2002; Delnevo et al., 2003; George and Waller, 2005). Accordingly, various studies have indicated that smoking behaviour has been found to be more widespread in individuals with EDs than in controls (Corte and Stein, 2000; John et al., 2006; Saules et al., 2004; Welch and Fairburn, 1998) and that AN individuals with bulimic symptomatology exhibited the highest rates (Haug and Guarda, 2001; Wiederman and Pryor, 1996a,b).

### 1.2. Alcohol and eating disorders

The prevalence estimate of alcohol use disorder (AUD) in ED patients has been reported to be as high as 30–50% (Dansky et al., 2000). A recent meta-analysis (Gadalla and Piran, 2007a) on the co-occurrence of EDs and alcohol use disorders including 41 studies found that the magnitude of the associations between ED patterns and AUD ranged from small to medium size and was statistically significant for any ED. The strongest relationship with alcohol use was found for bulimic BN individuals, followed by patients suffering from binge eating disorder (BED) and eating disorder not otherwise specified (EDNOS). However, no association was found between AN and AUD. In total, only 4 out of the 41 studies reported a negative relationship between disturbed eating behaviour and AUD.

### 1.3. Drug use and eating disorders

Finally, as regards to drug use, prevalence rates in treatment seeking ED patients have been indicated to vary between 7.9% and 32.6% (Corcos et al., 2001). A recent meta-analysis of 16 studies on the association between drug use and EDs found a higher prevalence of drug abuse for BN, the prevalence was lower for BED and people with AN had lower levels of drug

abuse than healthy populations (Calero et al., submitted for publication).

Most studies assessing drug use in ED patients have failed to specify the nature of the drug, whether it is a street drug (cocaine, heroin, stimulants) or a prescribed medication (tranquilizers, hypnotics, antidepressants). Differentiating the distinct classes of drugs is nevertheless imperative, since some drugs such as for instance cocaine and amphetamines are known to act as appetite suppressants and are therefore employed for the purpose of weight loss, while others such as cannabis have appetite-stimulating properties (Gadalla and Piran, 2007b; Nappo et al., 2002; Saules et al., 2004). The small number of studies that examined these distinct types of drugs separately demonstrated a positive relationship between dieting and bingeing (with or without purging) and stimulants, amphetamines, cocaine and psychotropic medications (Corcos et al., 2001; McCabe and Boyd, 2005; Piran and Robinson, 2006).

### 1.4. Cultural differences in substance use and EDs

Research on cultural differences in the comorbidity of substance use in ED patients has predominantly assessed ethnic groups living in Anglo Saxon societies (French et al., 1997; Granner et al., 2001). Only more recently have studies from Japan (Nagata et al., 2002), Mexico (Gutierrez et al., 2001) and some European countries (Beato-Fernández et al., 2007; García-Vilches et al., 2002) emerged. However, no study has undertaken a cross-cultural comparison study of substance use in EDs across various countries/regions. This omission in the literature leaves unanswered questions concerning how environmental factors among different cultures could influence the comorbidity of EDs and substance use. This study therefore reports on the prevalence of substance use in EDs across various ED subtypes in several European countries using a common instrument.

Taken together, there is evidence that tobacco, alcohol and drug use commonly co-occur with EDs and that this association is somewhat stronger with bulimic behaviours, than in individuals who are purely restrictive. Nevertheless, it should be acknowledged that little previous research has addressed this topic, and that the few findings that have been reported have been conflicting. Furthermore preceding research is complicated by methodological shortcomings, such as a failure to control for confounding variables, the heterogeneity of the populations (ages, diagnostic criteria, disorder subtypes, severity) and the variety of technologies used to evaluate substance abuse.

### 1.5. Aims of the study

The present study was part of the Fifth European Framework project on Healthy Eating, which is a collaboration of eight countries with the common task to examine the individual and environmental factors related to EDs. The overall aim of this study was to replicate and extend previous findings and include several methodological improvements. Primarily, we employed a large sample size of ED patients and healthy controls from various different European countries. Secondly, the present study included participants across the range of EDs including EDNOS

patients. Virtually nothing is known about EDNOS and substance use even though clinically it is the most common sort of ED (Dalle Grave and Calugi, 2007; Machado et al., 2007). The few studies assessing substance use in EDNOS patients have indicated a high rate of comorbidity also in these patients (Le Grange et al., 2006; Striegel-Moore et al., 1999). This exclusion is critical since the severity of psychopathology and degree of secondary psychosocial impairment in those with EDNOS has been found to be comparable to those seen in patients with AN or BN (Krug et al., 2008a; Ricca et al., 2001; Turner and Bryant-Waugh, 2004). Finally, we assessed a broad range of licit and illicit substances with differing physiological properties.

Our primary hypothesis is that people with binge eating will have a higher rate of substance abuse. A secondary hypothesis is that substances with appetite suppressant properties might be consumed more frequently than substances not containing these characteristics. A third hypothesis was that environmental differences such as the substance availability across cultures would be reflected in the prevalence of the ED population.

## 2. Method

### 2.1. Participants

The present study employed a case–control design. Six centers from five different European countries (two for Italy) participated in the current study: the University Hospital of Bellvitge, Barcelona, Spain (262-eating disorder (ED); 160-C (Controls)); the Department of Child and Adolescent Psychiatry, Medical University of Vienna (94-ED; 59-C); the Eating Disorders Research Unit, Institute of Psychiatry, London, UK (319-ED; 184-C); the Department of Neurology and Psychiatric Services, University of Florence, Italy (50-ED; 50-C); the Department of Psychiatry, Fondazione Centro del Monte Tabor, Milan, Italy (93-ED; 101-C) and the University Psychiatric Hospital, University of Ljubljana, Slovenia (61-ED; 231-C).

Entry into the study was between March 2001 and September 2002. The total sample comprised 1664 participants ( $n = 1555$  females;  $n = 109$  males), 879 ED patients (22.1% with AN-restrictive (AN-R), 20.0% with AN-binge-purging (AN-BP), 32.1% with BN and 25.8% with EDNOS) and 785 healthy controls. The mean age was 25.8 years (S.D. = 8.7). Due to the limited sample size of BN non-purging individuals a distinction between purging and non-purging BN subtypes could not be made.

Most of the ED participants were ascertained from clinical institutions and were ill at assessment. A small proportion (less than 20%) came from community sources e.g. user or carer organizations or from advertisements. Participants were diagnosed according to DSM-IV-R (APA, 2000a) criteria, using a semi-structured clinical interview [SCID-I (First et al., 1996)] or EATATE [only used in Austria and the UK (Anderluh et al., 2008)], carried out by experienced psychologists and psychiatrists. The interviewers were trained in the administration of these instruments although formal inter-rater reliability was not computed for this study.

The exclusion criteria for the present study were: (a) missing values for any diagnostic items DSM-IV-TR criteria (APA, 2000a) for AN, BN, or for EDNOS; (b) younger than 16 years old; (c) unable to complete the assessment because of cognitive impairment, mental retardation and/or serious medical condition; or, (d) current psychotic disorder. For the present analysis, the following individuals had to be excluded from an initial sample of 901 patients: (a) patients ( $N = 18$ ) with missing values for any diagnostic tools; (b) cognitive impairment ( $N = 2$ ); (c) comorbid psychotic disorder ( $N = 2$ ). Diagnostic decisions were made by psychologists or psychiatrists who completed the anamnesis together with the treatment team according to published treatment guidelines (APA, 2000b).

Healthy controls were ascertained from various community sources at each site and were asked to volunteer in a study of factors associated with the development of EDs. All controls were from the same catchment areas as index patients. The final control group included 785 volunteers. The exclusion criteria

for the control group were: (a) younger than 16 years; (b) a lifetime history of health or mental illnesses (including EDs), screened by the General Health Questionnaire-28 (Goldberg, 1981) the SCID I (First et al., 1996) according to DSM-IV-R criteria (APA, 2000a) and the EAT-26 [total score > 20 (APA, 1994; Garner et al., 1982)]. From the initial sample of 791 controls, 6 participants were excluded, who had had a lifetime ED. Each site obtained ethical approval separately from its own institutional review board.

### 2.2. Assessment

**2.2.1. The substance use subscale of the cross-cultural (environmental) questionnaire.** This retrospective self-administered questionnaire has 51 items with 6 subscales. It was developed by an expert group from various European countries in order to detect environmental factors associated with the development of EDs. The CCQ was based on the major instruments in the field of EDs, which are the Oxford Risk Factor Interview (Fairburn et al., 1997, 1998) and the McKnight Risk Factor Interview (Shisslak et al., 1999). It was developed by an expert group from various European countries in order to detect environmental factors associated with the development of EDs. A more detailed description of the CCQ can be found in an earlier publication (Fernandez-Aranda et al., 2007). A recent study (Penelo et al., submitted for publication) on the psychometric properties of the CCQ offers preliminary evidence that it is a useful and valid screening instrument to assess past and present risk factors of EDs in a variety of different countries.

In the current study, only the 13 items of the substance use domain were used. These assess both lifetime and current substance use. Licit substances include alcohol and tobacco (current tobacco use was defined as number of cigarettes smoked per day). Psychoactive substances were broken down into four discrete groups, including (1) cannabis (dope, hash or marijuana), (2) stimulants (cocaine, crack, amphetamines or speed); (3) opioids/heroin and tranquillizers (valium, Librium, mogadon or) and (4) other illegal drugs (LSD, magic mushrooms, ketamine, ecstasy, glue/aerosols). Other questions asked about the age that drug consumption began, number of cigarettes smoked per day and amount of alcohol consumed during a typical week (number of units ranged from 1 unit = 1 single (25 ml) measure of spirits e.g. whisky, gin or vodka to 28 units = 1 bottle (700 ml) of spirits), sense of loss of control over drinking and whether the person smoked cigarettes, or took legal or illegal drugs and/or medicine to influence appetite or weight. A copy of the whole instrument can be requested from the corresponding author.

**2.2.2. EATATE phenotype interview.** The EATATE interview was developed for the European Healthy Eating Project. It is a semi-structured interview, comprising a European adaptation of the longitudinal interval follow-up evaluation [LIFE, (Keller et al., 1987)] and the eating disorders examination [EDE, (Fairburn and Cooper, 1993)]. The interview is used to obtain a lifetime history of ED symptoms, which are then plotted on a lifeline. The EATATE instrument has been used previously in AN research (Anderluh et al., 2008) and demonstrates good inter-rater reliability in terms of diagnoses ( $\kappa = 0.82$ – $1.0$ ) and illness history variables ( $0.80$ – $0.99$ ).

**2.2.3. General health questionnaire-28 (GHQ-28).** The GHQ-28 is a self-report questionnaire that has been designed to detect and assess individuals with an increased probability of a present psychiatric disorder. The GHQ-28 has been studied in various European countries and has been found to be a valid and reliable tool (Goldberg, 1981).

**2.2.4. Eating attitudes test (EAT-26).** The EAT-26, which is an abbreviated version of the EAT-40 questionnaire (Garner and Garfinkel, 1979), assesses a broad range of symptoms and provides a total score for disturbed eating attitudes and behaviour. This instrument has acceptable criterion-related validity with Cronbach's alphas ranging from 0.82 to 0.89 in a previous study (Garner et al., 1982).

### 2.3. Procedure

Participants were invited to participate in a collaborative, multicenter study across Europe, investigating associated ED factors. All patients were first

assessed by board certified psychologists or psychiatrists using a two hour structured diagnostic face-to-face or phone interview to measure ED symptoms and psychopathological traits. Eating disorder diagnoses were based on this interview and were consensually derived among members of the clinical team who had participated in the assessment. An information sheet at the start of the questionnaire informed the participants about the purpose of the study and assured confidentiality of the results. Furthermore, it was emphasized that participation in the study was completely voluntary and that participants were free to withdraw from the study at any time.

2.4. Statistical analyses

The statistical analysis was carried out with the SPSS 15.0.1 program for Windows. First, prevalence rates of tobacco, alcohol and drug use were estimated, for the total European sample and for each country. Next, odds ratios for substance use comparing ED patients with controls were calculated through logistic regression models adjusted by sex, age and education. The adjusted OR value assessed the extent of the association between the presence of the disorder (independent variable) and the utilization of tobacco, alcohol and drugs (dependent variables): a significant OR higher than 1 indicates that the ED patients reported a higher probability of using substances than controls. Clinical significance was also estimated by the calculation of the effect size for proportions based on Cohen's *d* index (Cohen, 1988). Results were interpreted as small if *d* values were lower than 0.2, medium for *d* values ranging between 0.2 and 0.5 and large for *d* values higher than 0.5.

Second, the prevalence of substance use was compared across ED groups and also across geographical origins (country). The independent variables comprised the ED subtype (AN-R/AN-BP/BN/EDNOS) and the geographical origin (UK/Spain/Austria/Slovenia/Italy). Outcomes were the use of each substance. Statistical comparisons were based on logistic regressions adjusted by sex, age and education.

Finally, adjusted odds ratios (by sex, age and education) also compared the substance use between each ED subtype and the control group. A significant OR value higher than 1 indicates that the ED patients (diagnosed with a concrete ED subtype) had a higher risk of using substances than healthy controls.

Since multiple statistical testing was carried out, type-I error inflation was controlled through Bonferroni–Holm's adjustment (Holm, 1979).

3. Results

3.1. Socio-demographic description of the participants

Table 1 contains the socio-demographic characteristics for the total sample stratified by country. Age differed significantly between the two groups, with the eating disordered patients being older than the controls. The two groups also differed slightly in sex, with the ED group comprising significantly more females than the control group. There were no differences in the distribution of sex across ED subtypes ( $\chi^2 = 0.83; p = 0.84$ ). Furthermore more ED patients were employed and had grown up in urban places. Conversely, significantly more controls than ED patients were currently studying. The age of starting smoking and drinking did not differ between groups. The closeness of the population matching varied between countries. In the Slovenian sample in particular the ED patients were significantly older than the controls.

3.2. Comparison of substance use across gender

No statistically significant differences across sex were found for the prevalence estimates of substances use, except for lifetime (males 11.2% vs. females 22.8,  $p = 0.007$ ) and current

Table 1 Socio-demographic characteristics by country: percentages for categorical variables and mean (S.D.) for quantitative variables

	Total European		United Kingdom		Spain		Austria		Slovenia		Italy	
	ED (n=879)	Controls (n=785)	ED (n=319)	Controls (n=184)	ED (n=262)	Controls (n=160)	ED (n=94)	Controls (n=59)	ED (n=61) <sup>b</sup>	Controls (n=231)	ED (n=143)	Controls (n=151)
	AN-R=172	AN-R=156	AN-R=68	AN-R=40	AN-R=40	AN-R=40	AN-R=22	AN-R=22	AN-R=22	AN-R=42	AN-R=42	AN-R=42
	AN-BP=156	AN-BP=156	AN-BP=75	AN-BP=40	AN-BP=40	AN-BP=40	AN-BP=8	AN-BP=8	AN-BP=8	AN-BP=33	AN-BP=33	AN-BP=33
	BN=250	BN=250	BN=48	BN=113	BN=113	BN=113	BN=17	BN=17	BN=17	BN=57	BN=57	BN=57
	EDNOS=201	EDNOS=201	EDNOS=128	EDNOS=48	EDNOS=48	EDNOS=48	EDNOS=17	EDNOS=17	EDNOS=17	EDNOS=8	EDNOS=8	EDNOS=8
Age: mean (S.D.)	27.2 (8.9) <sup>a</sup>	24.3 (8.2) <sup>a</sup>	29.1 (11.4)	28.8 (11.3)	25.3 (5.6)	26.1 (5.5)	27.1 (8.3)	24.2 (6.3)	25.7 (7.0) <sup>a</sup>	18.7 (4.4) <sup>a</sup>	27.2 (7.7)	25.6 (6.1)
Gender: female (%)	96.6 <sup>b</sup>	91.2 <sup>a</sup>	97.2	98.9	93.9 <sup>a</sup>	85.5 <sup>a</sup>	100	96.6	98.2 <sup>a</sup>	83.0 <sup>a</sup>	97.2	98.0
Education level:												
Primary (%)	8.2 <sup>a</sup>	24.8 <sup>a</sup>	0 <sup>a</sup>	0 <sup>a</sup>	15.4 <sup>a</sup>	3.8 <sup>a</sup>	0	1.7	9.1 <sup>a</sup>	74.5 <sup>a</sup>	12.6 <sup>a</sup>	9.9 <sup>a</sup>
Secondary (%)	50.1 <sup>a</sup>	25.6 <sup>a</sup>	47.6 <sup>a</sup>	31.9 <sup>a</sup>	43.6 <sup>a</sup>	11.3 <sup>a</sup>	0	3.4	58.2 <sup>a</sup>	21.6 <sup>a</sup>	65.7 <sup>a</sup>	47.7 <sup>a</sup>
University (%)	41.8 <sup>b</sup>	49.6 <sup>a</sup>	52.4 <sup>a</sup>	68.1 <sup>a</sup>	40.9 <sup>a</sup>	84.9 <sup>a</sup>	100	94.9	32.7 <sup>a</sup>	3.9 <sup>a</sup>	21.7 <sup>a</sup>	42.4 <sup>a</sup>
Employment status: employed (%)	54.9 <sup>a</sup>	39.1 <sup>a</sup>	51.9	60.7	62.5 <sup>a</sup>	45.8 <sup>a</sup>	64.7	61.0	51.4 <sup>a</sup>	5.7 <sup>a</sup>	44.7	55.0
Students (%)	47.8 <sup>a</sup>	75.3 <sup>a</sup>	54.2	60.7	41.6 <sup>a</sup>	75.6 <sup>a</sup>	53.8 <sup>a</sup>	98.3 <sup>a</sup>	60.7 <sup>a</sup>	94.3 <sup>a</sup>	37.9 <sup>a</sup>	55.0 <sup>a</sup>
Area where brought up: urban (%)	69.0 <sup>a</sup>	56.8 <sup>a</sup>	70.2	68.9	73.8	77.8	80	55.9	38.2	31.6	69.0	58.9
Age started smoking: mean (S.D.)	17.1 (3.2)	16.6 (2.8)	16.4 (3.3)	16.8 (3.3)	16.9 (2.6)	17.4 (2.4)	17.8 (3.8)	16.4 (2.7)	17.6 (2.7) <sup>a</sup>	15.2 (1.8) <sup>a</sup>	18.3 (3.4)	17.8 (3.0)
Age started drinking alcohol: mean (S.D.)	18.6 (4.4)	18.1 (2.9)	18.6 (4.7)	18.1 (2.5)	17.8 (3.5)	18.7 (2.9)	19.1 (4.6)	17.2 (2.9)	18.1 (2.8)	16.2 (2.9)	19.0 (3.6)	20.1 (3.4)

<sup>a</sup> Significant comparison (with Bonferroni–Holm's correction) based on chi-square tests for categorical variables and *t*-test for quantitative variable. S.D.: standard deviation.

<sup>b</sup> Data from Slovenia is not included due the lack of diagnose subtype in this country.

(7.1% vs. 19.0%;  $p=0.003$ ) smoking instead of eating, currently smoking more than 10 cigarettes/day (8.9% vs. 17.6%,  $p=0.046$ ), lifetime sense of loss of control over drinking (26.3% vs. 41.4%,  $p=0.003$ ) and lifetime intake of legal drugs to influence appetite and weight (10.2% vs. 18.4%,  $p=0.041$ ). Comparisons stratified by diagnosis status (separate analyses for ED and control participants) showed no statistical differences by sex for substance use in the ED patients cohort. However, considering only control participants, compared to men, women reported currently higher percentage of sense of loss of control over drinking (22.9% vs. 8.7%,  $p=0.006$ ), higher prevalence of daily smoking (at least 10 cigarettes/day; 10.8% vs. 1.7%,  $p=0.028$ ), higher proportion of smoking instead of eating (9.9% vs. 1.5%,  $p=0.021$ ) and lower proportion of cannabis (37.7% vs. 50.0%,  $p=0.047$ ) and other drugs use (5.1% vs. 11.6%,  $p=0.027$ ).

### 3.3. Lifetime and current comorbidity for substance use: OR values

Regarding the association between substance use in the total European sample, comorbidities (OR coefficients adjusted by sex, age and education) showed a clear positive lifetime and current co-occurrence between tobacco and drugs and between alcohol and drugs, in both ED and control cohorts. These coefficients were also significant when stratified by ED subtype. OR values for alcohol and drugs ranged between 2.9 (control cohort) and 6.1 (AN-BP subtype), and between 1.7 (EDNOS subtype) and 8.0 (AN-R subtype) for tobacco and drugs. While lifetime tobacco and lifetime alcohol use were also related, no significant relationship were revealed for current use of these substances. Results stratified by country were quite similar, with only a few exceptions located in the control cohorts: (a) lifetime tobacco and lifetime alcohol consumption were not associated in Spain (OR = 1.70,  $p=0.356$ ) and Italy (OR = 2.07,  $p=0.092$ ); (b) current alcohol and current drug use were not statistically correlated in Spain (OR = 2.33,  $p=0.141$ ), Austria (OR = 1.90,  $p=0.467$ ) and Slovenia (OR = 2.54,  $p=0.103$ ); and finally (c) current tobacco and current alcohol use were related in Spain (OR = 5.65,  $p=0.010$ ) and Austria (OR = 5.39,  $p=0.012$ ).

### 3.4. Comparison of substance use between ED patients and controls

Fig. 1 summarizes the global comparison of tobacco, alcohol and drug use between ED patients and controls, adjusted by age, sex and education, for the whole sample and by countries. The presence of an ED (disorder) was positively associate with the use of tobacco in the total European sample (lifetime use: OR = 1.74; current use: OR = 1.72), in the UK (lifetime use: OR = 2.57; current use: OR = 2.25), in Spain (lifetime use: OR = 2.00; current use: OR = 1.77) and Italy (current use: OR = 1.85). Similarly a positive relationship between total drug use was revealed for the total European sample (lifetime use: OR = 2.25; current use: OR = 2.30), the UK (lifetime use: OR = 2.74; current use: OR = 2.05), Spain (lifetime use: OR = 1.61), Slovenia (lifetime use: OR = 2.55) and Italy (lifetime use: OR = 1.72). However, the occurrence of current alcohol use was lower for ED patients than controls in the UK (OR = 0.52) and Italy (OR = 0.33).

Table 2 shows the detailed comparison of lifetime and current substance use for controls and ED patients. For the total European sample, lifetime prevalence estimates were significantly higher for ED patients than healthy controls for tobacco (47.5% vs. 35.1%,  $p<0.0005$ ), alcohol (34.1% vs. 26.9%,  $p=0.002$ ) and drug (61.3% vs. 43.3%,  $p<0.0005$ ) use. As regards to current use, estimates were higher for ED patients than controls for tobacco (34.8% vs. 24.2%,  $p<0.0005$ ) and drug (34.4% vs. 22.1%,  $p<0.0005$ ) use but not for alcohol (24.6% for ED vs. 26.1% for healthy subjects,  $p=0.481$ ) consumption. OR coefficients that measure the degree of association between substances use and the presence of the disorders showed that compared to controls, ED patients reported a higher prevalence estimate for all substances, except for alcohol and cannabis use. Furthermore, compared to controls, ED patients endorsed the reason for substance use as an appetite suppressant significantly more often: smoking instead of eating (OR = 5.11) and taking legal drugs (OR = 8.38) or illegal drugs (OR = 6.00) to influence appetite–weight.

Similar patterns were observed for current tobacco, alcohol and drug use. Number of cigarettes smoked per day was higher

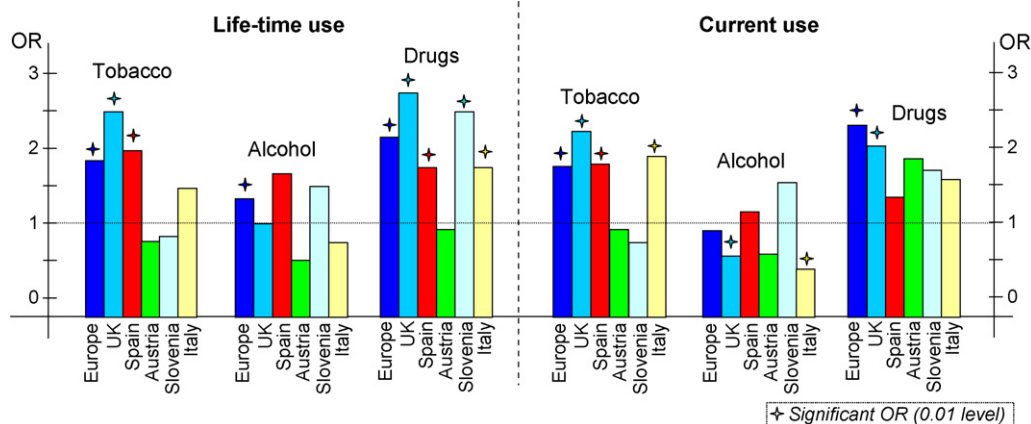


Fig. 1. Comparison for ED patients vs. control (OR adjusted by age, sex and education).

Table 2  
Comparison of prevalence for lifetime and current substances use

	Comparison: ED patients vs. controls				Patients with ED: comparison for diagnose subtype					Patients with ED: comparison for precedence					
	Controls (n = 785) (%)	ED (n = 879) (%)	Odds ratio <sup>a</sup>	Effect size <sup>b</sup>	AN-R (n = 172) (%)	AN-BP (n = 156) (%)	BN (n = 250) (%)	EDNOS (n = 201) (%)	p	UK (n = 319) (%)	Spain (n = 262) (%)	Austria (n = 94) (%)	Slovenia (n = 61) (%)	Italy (n = 143) (%)	p
<b>Lifetime</b>															
<b>Tobacco</b>															
Ever smoked on regular basis	35.1	47.5	1.52*	0.254	35.5	55.3	57.4	44.3	0.003	39.9	56.3	52.2	32.7	49.3	<0.0005
Ever smoked instead of eating	9.2	34.1	<b>5.11*</b>	0.634	17.5	43.6	45.3	31.5	<0.0005	32.5	43.1	36.0	21.4	24.8	<0.0005
<b>Alcohol</b>															
Ever drink alcohol on a regular basis	26.9	34.1	1.40*	0.157	31.3	43.2	29.5	<b>43.7</b>	0.010	62.8	15.1	34.4	16.1	17.0	<0.0005
Sense of loss of control over drinking	21.5	57.9	<b>6.10*</b>	0.801	42.9	64.6	77.1	53.5	<0.0005	47.9	87.1	29.7	10.7	63.6	<0.0005
<b>Drugs</b>															
Legal to influence appetite–weight	4.5	30.3	<b>8.38*</b>	0.724	10.8	34.4	43.3	28.6	<0.0005	32.9	29.8	29.3	23.6	29.1	0.617
Illegal to influence appetite–weight	1.5	9.1	<b>6.00*</b>	0.344	3.0	10.5	15.1	7.6	0.022	10.6	8.3	9.8	7.3	7.9	0.565
Ever taken cannabis	38.9	40.7	1.28	0.037	27.5	40.5	<b>49.8</b>	42.6	<0.0005	44.8	43.8	36.3	40.0	29.8	0.075
Ever taken stimulants	6.2	17.2	3.03*	0.347	3.6	24.7	24.7	17.2	<0.0005	19.4	20.8	12.1	9.1	12.8	0.070
Ever taken opioids	5.7	20.1	3.85*	0.440	10.8	31.0	27.7	14.0	<0.0005	24.0	22.2	13.2	3.6	19.1	0.062
Ever used other illegal drugs	5.7	12.7	2.68*	0.244	6.1	22.2	13.4	12.3	0.001	19.6	9.4	7.8	10.9	8.5	0.001
<b>Comorbidity</b>															
Ever taken tobacco and alcohol	11.4	21.1	1.88*	0.265	15.5	26.2	22.4	25.4	0.312	32.2	12.0	29.2	10.9	14.3	<0.0005
Ever taken alcohol and drugs	6.6	16.3	2.61*	0.308	8.1	27.0	19.8	14.6	0.001	28.7	7.7	13.6	9.1	10.8	<0.0005
Ever taken tobacco and drugs	7.9	21.4	3.06*	0.389	10.6	29.8	29.6	17.9	<0.0005	22.0	25.6	16.9	11.1	20.0	0.148
Ever taken tobacco-alcohol-drugs	5.1	12.0	2.42*	0.249	5.7	18.4	15.4	11.2	0.020	18.4	6.9	12.6	7.4	9.4	0.009
<b>Current</b>															
<b>Tobacco</b>															
Currently smoke cigarettes	24.2	34.8	1.56*	0.234	22.9	47.0	46.7	24.9	<0.0005	21.6	46.3	44.0	19.6	40.8	<0.0005
Number of cigarettes/day: >10	9.9	23.9	2.68*	0.380	21.5	22.6	32.1	21.9	0.100	21.2	29.8	27.0	12.2	24.5	0.110
Currently smoke instead of eating	9.1	26.8	3.66*	0.474	11.0	36.9	39.4	21.1	<0.0005	21.0	36.5	28.2	11.3	26.1	<0.0005
<b>Alcohol</b>															
Currently drink alcohol	26.1	24.6	0.92	0.034	20.7	29.3	19.7	<b>38.3</b>	<0.0005	48.1	9.5	23.9	7.1	10.6	<0.0005
Amount of alcohol: >21 units/week	3.0	3.9	1.41	0.049	1.2	6.0	3.8	6.7	0.132	9.4	0.4	2.2	0.0	1.4	0.007
Sense of loss of control over drinking	10.5	24.4	<b>3.04*</b>	0.373	17.7	31.8	29.2	25.6	0.011	34.5	22.9	20.0	3.6	17.7	<0.0005
<b>Drugs</b>															
Currently take cannabis	20.0	23.6	<b>1.64*</b>	0.087	17.1	23.6	<b>29.8</b>	24.5	0.050	29.6	25.5	8.9	18.2	21.3	0.153
Currently take stimulants	1.0	7.8	9.29*	0.336	0.0	12.1	11.4	8.3	0.809	9.9	10.2	2.2	1.8	6.4	0.240
Currently take opioids	2.3	13.6	6.54*	0.427	7.0	22.1	16.4	10.3	0.014	16.6	16.6	6.6	1.8	13.5	0.160
Currently take other Illegal drugs	2.0	3.7	2.38	0.102	1.4	5.1	5.8	3.7	0.268	6.0	3.3	1.1	0.0	4.3	0.350
<b>Comorbidity</b>															
Currently take tobacco and alcohol	6.7	9.1	1.22	0.089	4.8	12.8	11.3	8.9	0.034	11.1	6.3	15.6	3.6	7.8	0.286
Currently take alcohol and drugs	1.7	6.9	3.99*	0.258	1.4	12.6	7.0	11.7	0.008	13.7	5.6	4.5	0.0	4.3	0.016
Currently take tobacco and drugs	2.0	10.2	5.74*	0.348	3.6	16.2	13.9	7.9	0.017	8.0	13.4	6.9	1.9	12.9	0.166
Currently take tobacco, alcohol and drugs	0.9	4.3	5.18*	0.215	0.7	8.2	5.1	5.6	0.076	4.8	4.7	4.6	0.0	4.3	0.994

ED: eating disorder; AN-R: anorexia nervosa restrictive subtype; AN-BP: anorexia nervosa bulimic and/or purging subtype; BN: bulimia nervosa; EDNOS: eating disorder not otherwise specified. UK: United Kingdom. Comparison based logistic regression models adjusted by sex, age and education. \*  $p < 0.01$  – most relevant values are represented in bold and are stated in the text.

<sup>a</sup> Significant adjusted OR (with Bonferroni–Holm’s correction).

<sup>b</sup> Coefficient based on Cohen’s  $d$ .

in the ED group compared to the control group (OR = 2.68). However, no significant differences were observed between both groups for current alcohol use and amount of alcohol drunk per week. Yet loss of control over drinking was higher in ED patients than controls for both lifetime (OR = 6.10) and current (OR = 3.04) measures. Finally, current cannabis use was higher in ED patients than controls (OR = 1.64).

### 3.5. Comparison of substance use across diagnostic subtypes of ED

Within the ED patients, BN and AN-BP patients had the highest prevalence for most lifetime and current tobacco, drug use and comorbid substance use variables whereas AN-R participants generally displayed the lowest, followed by EDNOS patients. However, as regards to lifetime and current alcohol consumption EDNOS patients exhibited the highest prevalence estimates (lifetime use:  $p = 0.010$ ; current use:  $p < 0.0005$ ). Interestingly for both lifetime and current alcohol use AN-R individuals also revealed higher values than BN but not AN-BP patients. Finally for lifetime and current cannabis use, the EDNOS sample also reported higher values than the AN-BP but not BN group (lifetime use:  $p < 0.0005$ ; current use:  $p = 0.050$ ).

Similar findings can be found in Table 3, where the first column contains  $p$ -values for the comparison of controls vs. AN-R, AN-BP, BN and EDNOS. This is the significance level obtained selecting controls as reference group in the logistic models. Most comparisons are significant. The other columns contain the ORs which have been obtained for the comparison of each diagnostic subtype and controls. Generally, compared to controls, BN and AN-BP patients display a significantly higher risk for consuming tobacco, drugs and co-occurring substance use but not alcohol consumption. For lifetime alcohol use only AN-BP and EDNOS patients report higher risk than the controls, but for current use the results are statistically equal for all types of EDs. Finally, AN-R patients generally have an equal risk than controls to abuse all kind of substances.

### 3.6. Comparison of substance use in ED patients coming from different countries

Table 2 shows that the highest levels of tobacco use were found in Spain and Austria, and the lowest in Slovenia. Regular drinking was more frequent ( $p < 0.0005$ ) in the UK, followed by Austria. Regarding comorbidities, alcohol was specially associated with tobacco ( $p = 0.034$ ) and drugs ( $p = 0.008$ ), with the highest co-occurrences in UK and Spain. In relation to current use, the patterns of prevalence were quite similar, excepting the use of more than 10 cigarettes/day and the comorbidities, with no differences across countries (the only exception was the simultaneous use of alcohol and drugs, with higher prevalences for UK,  $p = 0.016$ ). Finally, the comparison of ED samples from different countries for lifetime substance use showed no statistical differences in drugs, except for other illegal drugs ( $p = 0.001$ ).

## 4. Discussion

We were able to partially confirm our initial hypothesis in that we found that the prevalence of smoking, and drug use as well as the majority of the co-concurrent substance use variables were higher in the ED patients than the control group. Conversely, overall there was no higher level of alcohol consumption. Our second hypothesis, that ED patients would consume significantly more substances with appetite suppressant properties was only partially confirmed. While we revealed that tobacco use was higher in the ED group, stimulants were not used significantly more commonly than opioids and cannabis. Our third hypothesis was also only partially confirmed since we found that BN and AN-BP patients consumed tobacco and drugs more commonly than the remaining ED subgroups. However, alcohol was most frequently employed by EDNOS and AN-BP patients. Finally, our fourth hypothesis that cross-cultural difference would emerge was confirmed only to some extent, since only a few differences across countries were detected.

### 4.1. Substance use in eating disordered individuals and healthy controls

**4.1.1. Tobacco use and eating disorders.** Our first aim was to assess whether ED individuals and controls differed in the consumption of tobacco, alcohol and drugs. In accordance with previous studies (Anzengruber et al., 2006; Saules et al., 2004; Welch and Fairburn, 1998; Wiseman et al., 1998) the present findings indicated that the presence of an ED was positively associated with the use of both lifetime and current tobacco use in the total European sample. Moreover, we also revealed that ED individuals employed smoking significantly more often as a weight control method than healthy controls. Similarly, various studies have indicated that women concerned about their body weight were more likely to start smoking than those with fewer weight concerns and less dissatisfaction with body shape (Croll et al., 2002).

**4.1.2. Alcohol use and eating disorders.** We found no differences between ED patients and controls in lifetime and current alcohol consumption and the amount of alcohol drunk per week. This contrast previous reviews which have generally found a positive association between alcohol use and EDs (Gadalla and Piran, 2007b; Holderness et al., 1994). Low statistical power could to some extent explain these discrepant findings or it is possible that European samples differ from North American samples in this respect. However, although eating disordered patients were not regular heavy drinkers they reported more frequently a sense of loss of control over drinking (the effect size for this variable was high).

**4.1.3. Drug use and eating disorders.** With regards to drug use we found that the odds of lifetime and current drug use were higher for the ED patients than the healthy controls. These results agree with previous reviews (Calero et al., submitted for publication; Holderness et al., 1994). However, when different

Table 3  
Comparison of the prevalence for lifetime and current substances use between each diagnosis subtype and controls: OR adjusted by age, sex and education

	<i>p</i>	AN-R	AN-BP	BN	EDNOS
<b>Lifetime</b>					
<b>Tobacco</b>					
Ever smoked on regular basis	<0.0005	1.05	2.13 <sup>a</sup>	2.11 <sup>a</sup>	1.28
Ever smoked instead of eating	<0.0005	2.01 <sup>a</sup>	7.96 <sup>a</sup>	8.47 <sup>a</sup>	4.17 <sup>a</sup>
<b>Alcohol</b>					
Ever drink alcohol on a regular basis	<0.0005	1.29	2.03 <sup>a</sup>	1.11	2.07 <sup>a</sup>
Sense of loss of control over drinking	<0.0005	3.47 <sup>a</sup>	7.56 <sup>a</sup>	18.4 <sup>a</sup>	4.85 <sup>a</sup>
<b>Drugs</b>					
Legal to influence appetite–weight	<0.0005	2.49 <sup>a</sup>	10.30 <sup>a</sup>	14.80 <sup>a</sup>	7.54 <sup>a</sup>
Illegal to influence appetite–weight	<0.0005	2.28	7.35 <sup>a</sup>	9.73 <sup>a</sup>	5.26 <sup>a</sup>
Ever taken cannabis	<0.0005	0.70	1.26	1.94 <sup>a</sup>	1.31
Ever taken stimulants	<0.0005	0.63	4.98 <sup>a</sup>	4.70 <sup>a</sup>	2.79 <sup>a</sup>
Ever taken opioids	<0.0005	2.07	6.75 <sup>a</sup>	5.76 <sup>a</sup>	2.24 <sup>a</sup>
Ever used other illegal drugs	<0.0005	1.31	5.47 <sup>a</sup>	2.93 <sup>a</sup>	2.35 <sup>a</sup>
<b>Comorbidity</b>					
Ever taken tobacco and alcohol	<0.0005	1.43	2.47 <sup>a</sup>	2.04 <sup>a</sup>	2.24 <sup>a</sup>
Ever taken alcohol and drugs	<0.0005	1.40	4.93 <sup>a</sup>	3.33 <sup>a</sup>	1.93 <sup>a</sup>
Ever taken tobacco and drugs	<0.0005	1.45	4.80 <sup>a</sup>	4.77 <sup>a</sup>	2.04 <sup>a</sup>
Ever taken tobacco-alcohol-drugs	<0.0005	1.30	4.08 <sup>a</sup>	3.23 <sup>a</sup>	1.87
<b>Current</b>					
<b>Tobacco</b>					
Currently smoke cigarettes	<0.0005	0.93	2.79 <sup>a</sup>	2.32 <sup>a</sup>	0.98
Number of cigarettes/day: >10	<0.0005	2.16 <sup>a</sup>	2.73 <sup>a</sup>	4.13 <sup>a</sup>	2.49 <sup>a</sup>
Currently smoke instead of eating	<0.0005	1.10	6.29 <sup>a</sup>	6.72 <sup>a</sup>	2.60 <sup>a</sup>
<b>Alcohol</b>					
Currently drink alcohol	0.014	0.72	1.21	0.69	1.69
Amount of alcohol: >21 units/week	0.630	0.46	2.21	1.25	2.42
Sense of loss of control over drinking	<0.0005	1.95 <sup>a</sup>	4.78 <sup>a</sup>	4.09 <sup>a</sup>	2.99 <sup>a</sup>
<b>Drugs</b>					
Currently take cannabis	<0.0005	1.13	1.64	2.40 <sup>a</sup>	1.66
Currently take stimulants	<0.0005	0.01	16.0 <sup>a</sup>	14.1 <sup>a</sup>	10.5 <sup>a</sup>
Currently take opioids	<0.0005	3.66 <sup>a</sup>	11.3 <sup>a</sup>	7.60 <sup>a</sup>	4.99 <sup>a</sup>
Currently take other Illegal drugs	0.018	0.94	3.41	4.00 <sup>a</sup>	2.14
<b>Comorbidity</b>					
Currently take tobacco and alcohol	0.280	0.49	2.09	1.59	1.09
Currently take alcohol and drugs	<0.0005	0.93	7.96 <sup>a</sup>	3.54 <sup>a</sup>	7.30 <sup>a</sup>
Currently take tobacco and drugs	<0.0005	2.22	10.1 <sup>a</sup>	7.47 <sup>a</sup>	4.59 <sup>a</sup>
Currently take tobacco, alcohol and drugs	<0.0005	1.03	11.6 <sup>a</sup>	5.35 <sup>a</sup>	7.02 <sup>a</sup>

AN-R: anorexia nervosa restrictive subtype; AN-BP: anorexia nervosa bulimic and/or purging subtype; BN: bulimia nervosa; EDNOS: eating disorder not otherwise specified. Comparison based on logistic regressions adjusted by sex, age and education. The column with *p*-values corresponds to the global comparison between ED subtypes and control cohort.

<sup>a</sup> Significant adjusted OR (with Bonferroni–Holm’s correction).

types of drugs and lifetime and current drug use were assessed individually, no statistically significant differences were found for lifetime cannabis use and current use of illegal drugs. Moderately weak effects may to some extent explain these incoherent findings.

In contrast to our expectations, drugs containing appetite suppressant properties were not consumed more frequently than the other types. However, in accordance with our predictions eating disturbed individuals stated that they employed legal or illegal drugs to influence weight and appetite, significantly more often than controls (Nappo et al., 2002).

**4.1.4. Comorbidity of tobacco, alcohol and drugs in eating disorders.** The finding of substance use comorbidity was

similar to that found in previous reports (Blinder et al., 2006; Ross and Ivis, 1999; Wiederman and Pryor, 1996b). In accordance with our findings, researchers have suggested that individuals who consume more than one substance may have specific personality vulnerability factors (Alvarez-Moya et al., 2007; Baker et al., 2007; Davis and Claridge, 1998; Holderness et al., 1994). Although in a previous study (Alvarez-Moya et al., submitted for publication), common personality traits (namely higher novelty seeking and both lower self-directedness and reward dependence) were observed in patients with EDs and comorbid substance abuse, empirical evidence about the existence of an “addictive personality” is as yet inconclusive (Conason et al., 2006; Holderness et al., 1994).



#### 4.2. Comparison of substance use between subtypes of ED

The findings from this study confirm previous studies in revealing that BN and AN-BP patients had the highest risk of smoking (Haug and Guarda, 2001; Wiederman and Pryor, 1996b) and drug use (Blinder et al., 2006; Calero et al., submitted for publication; Fernandez-Aranda et al., 2008). The result of lifetime and current alcohol consumption that was higher in EDNOS than in BN individuals also fits with findings in the literature (Corte and Stein, 2000; Grilo et al., 1995a,b; Schmidt et al., 2006).

The increased risk of substance abuse in people with bulimic symptomatology might be related to differences in temperament such as higher levels of disinhibition or impulsivity in this group (Fernandez-Aranda et al., 2006; Fernandez-Aranda et al., 2008; Thompson-Brenner et al., 2008). Another possibility is that this is an acquired change in reward sensitivity (O'Brien and Treasure, submitted for publication; Treasure, 2007; Piran and Gadalla, 2007; Gadalla and Piran, 2007b). Understanding the link between addictions and bulimic symptomatology, especially binge eating has also been increased by the development of animal models. Animals "binge eat" if they are exposed to some of the environmental factors (food restriction, street, intermittent exposure to highly palatable food etc.) thought to play a role in the development of human EDs (Avena et al., 2005; Corwin, 2006; Corwin and Hajnal, 2005; Corwin and Buda-Levin, 2004; Lewis et al., 2005; Rada et al., 2005). Research has indicated that not only do these animals over eat palatable food but they have also been shown to be more prone to develop addictive behaviours when exposed to alcohol and cocaine (Koob and Le Moal, 2005; Robinson and Berridge, 2003).

#### 4.3. Substance use in eating disorders across countries

The fourth aim of the present study was to examine whether there were differences across countries in tobacco, alcohol and drug use. Some differences across countries emerged. Both lifetime and current tobacco use was found to be higher in patients from the UK and Spain. A similar trend was found for lifetime drug use. This parallels the findings from a current report on drug consumption in European populations which reported that Spain and the UK had the highest substance use prevalence rates (European Monitoring Centre for Drugs and Drug Addiction, 2007). These findings suggest that it is the relative accessibility of drugs as evidenced by population levels that determines the level of usage in ED patients.

#### 4.4. Limitations

The results of this study must be interpreted within the context of some methodological limitations. Firstly, the retrospective, self-report data collection procedures and the case mix including a high proportion of clinical cases may have limited the validity and the reliability of our findings. Secondly, as the study was correlational, we cannot draw firm conclusions about the direction of the relationships between the problem behaviours and the dispositional variables. Thirdly, we did not have suffi-

cient information to accurately time the age of onset of the ED, and so we were unable to examine the temporal aspects of drug use in relation to this. Fourthly, we were not able to differentiate between alcohol use, abuse and dependence. Fifthly, it was not possible to quantify the common comorbidities associated with EDs i.e. depression, anxiety, obsessive compulsive disorder. Finally, the sample sizes (for ED subtypes and control cohorts) and the success of the matching between controls and patients varied between the different countries, which could have affected the accuracy of the *p*-values and the estimations in the regression models. Notwithstanding these limitations, we were able to assess the nature of the comorbid relationship between EDs and substance use in a large and phenotypically well-characterized sample of individuals with EDs across five European countries.

#### 4.5. Treatment implications

These results emphasize the importance of assessing substance use in individuals with disturbed eating behaviour, and vice versa. As regards to treatment it may be that treatment focused on both eating and addictive behaviours together may be warranted (Benjamin and Wulfert, 2005; Sinha and O'Malley, 2000). Preferably such treatment ought to focus on characteristics of both disorders, which could be accomplished by employing psychoeducation, the assessment of high risk situations and relapse prevention techniques (Benjamin and Wulfert, 2005; Ricciardelli and McCabe, 2001; Sinha and O'Malley, 2000). Finally, clinicians should also try to modulate unconstructive emotional conditions or impulsive stress and/or anxiety release, which could be achieved by incorporating affect-oriented elements (e.g. dialectical behaviour therapy) with the goal of improving the adaptive management of these emotions (Krug et al., 2008b; McMMain et al., 2001).

#### 4.6. Conclusion

This is the first study examining the relationship between EDs and lifetime and current tobacco, alcohol and drug use of a wide range of drug classes and ED diagnoses across different European countries. The association between substance use and binge eating disorders in particular has been confirmed. Longitudinal designs which examine the potential mediating role of dysregulated eating as a risk factor for substance use will be of interest.

#### Conflict of interest

All other authors declare that they have no conflicts of interest.

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**Contributors:** All authors designed the study, wrote the protocol and managed the literature searches and summaries of previous related work. Roser Granero and Eva Penelo undertook the statistical analysis, and Isabel Krug, Janet Treasure and Fernando Fernandez-Aranda wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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