








Food addiction and lifetime alcohol and illicit drugs use in specific eating disorders

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FULL-LENGTH REPORT



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ABSTRACT

Background and aims: Food addiction (FA) and substance use (SU) have frequently been reported in patients with eating disorders (EDs). Our study aimed to assess the prevalence rates of FA and/or lifetime problematic alcohol and illicit drug use among patients with specific ED, such as: bulimia nervosa (BN), binge eating disorder (BED), and other specified feeding and eating disorder (OSFED). We sought to identify clinical, psychopathological, and personality profiles involved in these addictive behavior-based phenotypes. **Methods:** The total sample was 527 patients (176 BN, 115 BED, and 236 OSFED). FA was assessed through the Yale Food Addiction Scale 2.0. To determine lifetime SU, a semi-structured clinical interview was carried out. **Results:** Patients with BN had the highest rates of FA both with and without SU. No gender differences were obtained for the prevalence of current FA and/or lifetime SU. Patients reporting at least one addictive-related behavior exhibited increased clinical severity compared to those who reported none. Increased impulsivity (such as high lack of premeditation, sensation seeking, and positive urgency) and low self-directedness were differentiating factors for presenting one or two addictive behaviors. **Discussion and Conclusions:** Overall, patients presenting with at least one addictive-like behavior reported a poorer clinical status than those without. Also, patients with FA and SU exhibited a more dysfunctional profile characterized by high impulsivity and low self-directedness. These findings would support the need for targeted treatments to reduce impulsivity and increase self-directedness, especially in patients with any addictive-related behavior, as a step towards improving their treatment outcome.

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KEYWORDS

eating disorders, food addiction, impulsivity, personality, substance use

INTRODUCTION

Eating disorders (EDs) are mental illnesses characterized mainly by maladaptive eating behaviors with significant physical and psychosocial impairments. Based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013), the EDs include bulimia nervosa (BN), binge eating disorder (BED), anorexia nervosa (AN), and other specified eating disorders (OSFED), among others. The first two diagnostic categories (BN and BED) are mainly characterized by the presence of binge eating episodes (i.e., excessive food intake in a short period accompanied by a sense of loss of control) as the main symptom. The major difference between these two diagnoses is that the former exhibits compensatory behaviors (such as fasting and/or purging behaviors including self-induced vomiting; laxative or diuretic abuse), and the latter does not engage in these behaviors. AN is defined by restriction of food intake leading to weight loss or failure to gain weight. On the other hand, OSFED is a formal diagnostic category that includes heterogeneous nosological entities that do not meet the full diagnostic criteria of other EDs but are no less severe.

The comorbidity of EDs and substance use disorder (SUD) has frequently been reported with rates ranging from 21% to 50%, and varying among the ED diagnostic types (Bahji et al., 2019; Fouladi et al., 2015). Most studies have reported that comorbid SUD is most prevalent in BN, followed by BED, AN, and lastly, eating disorders not otherwise specified (EDNOS)/OSFED (Bahji et al., 2019; Fouladi et al., 2015). Overall, comorbid SUD is less common in patients with restrictive behaviors [namely restrictive AN (AN-R)] compared to those with binge-purging symptomatology (Anzengruber et al., 2006; Krug et al., 2009; Root et al., 2010). Although Baker, Mitchell, Neale, and Kendler (2010) were not able to find differences in the SUD prevalence between women with AN and BN, these authors described differences in the chronology of onset of both EDs and SUD. In this regard, while women with BN reported that their ED symptomatology preceded the development of SUD, for patients with AN it was the opposite (Baker et al., 2010). Patients with binge-purging behaviors often exhibit high impulsivity and low inhibitory control (Bogusz et al., 2021). These impulsive traits have also been related to food cravings, similar to substance cravings in patients with SUD (Polk, Schulte, Furman, & Gearhardt, 2017). In addition, both pathologies present difficulties in emotion regulation, which acts as a common underlying mechanism that impacts impulse control and predisposes to the development of addictive patterns (Gregorowski, Seedat, & Jordaan, 2013; Lozano-Madrid et al., 2020).

Similarly, in the last years, there has been a growing interest in studying the comorbidity of food addiction (FA) in EDs. Although FA has not yet been recognized as a diagnostic entity *per se*, it seems to share some clinical characteristics and neurobiological mechanisms (e.g. reward system and the dopaminergic pathways) with other addictions, both substance-related (Hardy, Fani, Jovanovic, &

Michopoulos, 2018; Hebebrand et al., 2014) and behavioral addictions (Um, Whitt, Revilla, Hunton, & Cyders, 2019). It has even been proposed that interventions for other SUDs may prove useful in the treatment of FA (Blumenthal & Gold, 2010). Similar to substances of abuse, palatable foods appear to have reinforcing effects characteristic of addictive processes (Bonder, Davis, Kuk, & Loxton, 2018; Volkow, Wang, Fowler, Tomasi, & Baler, 2011). FA is highly prevalent in patients with binge eating symptomatology such as BN, BED, and OSFED (Gearhardt, White, & Potenza, 2011; Granero et al., 2014; Jimenez-Murcia et al., 2019; Romero et al., 2019). Patients with ED and comorbid FA had increased psychopathology, more severe ED symptomatology, and higher impulsivity traits (Gearhardt, Boswell, & White, 2014; Jimenez-Murcia et al., 2019; Khalil et al., 2020). In addition, a recent prospective study identified that FA was associated with poor treatment outcome in patients with BED (Romero et al., 2019). Furthermore, recent studies show increasing interest in the relationship between FA and AN because of the strikingly high prevalence of FA in these patients (reporting rates from 47% to 84%) (Fauconnier et al., 2020; Granero et al., 2018; Tran et al., 2020). The study of Tran et al. (2020) suggests that the comorbid FA may represent a more severe variant of AN. However, conceptualizing AN-R with FA is somewhat debatable. Patients with AN, especially the restrictive subtype (AN-R), show food deprivation and seem to be the opposite of FA (Fauconnier et al., 2020). In this vein, Mallorquí-Bagué et al. (2020) suggested that patients with AN showed successful down-regulation of food craving, despite the presence of FA symptomatology. The question of whether patients with AN actually show such high FA rates or, rather, reflect a subjective fear of losing control with high-caloric food is controversial so far. Therefore, the current literature suggests the need for further research to explore how patients with ED, and especially restrictive AN, can interpret FA items (Albayrak et al., 2017).

A general population-based study found that women with FA and women with SUD shared similar psychological characteristics, reporting more depression, emotion dysregulation, lack of impulse control, and difficulties in goal-directed behaviors when compared with women without addiction (Hardy et al., 2018). Similarly, the co-occurrence of FA and other addictive-like behaviors has been related to poorer emotional and psychological states (Canan, Karaca, Sogucak, Gecici, & Kuloglu, 2017; Jiménez-Murcia et al., 2017; Tinghino et al., 2021). Most studies have separately explored SUD or FA among patients with EDs so far (Jimenez-Murcia et al., 2019; Lozano-Madrid et al., 2020; Romero et al., 2019). However, it could be interesting to analyze the co-occurrence of different addictive behaviors given the common risk factors observed at psychological, genetic, and neuronal levels, which could potentially have an important epidemiological relevance (Kotlyuk et al., 2020). In EDs, there are hardly any studies examining the co-occurrence of both addictive behaviors (i.e., SUD and FA) among EDs so far. A study conducted with men with heroin use disorder reported a high co-occurrence of BED and FA



which, in turn, was associated with increased craving and more suicide attempts (Canan et al., 2017). Likewise, a recent study observed overlapping risk factors linked to impulsive personality traits in youth with FA or alcohol misuse (Minhas et al., 2021). Further, concurrent FA and alcohol use disorder can predict binge eating in women from a community sample (Levallius, Monell, Birgegård, Clinton, & ForsénMantilla, 2020).

Thus, given this background and the above-mentioned gaps in the literature, the objectives of this study were fourfold: 1) to assess the prevalence of current FA and/or lifetime problematic SU among a large sample of patients with different ED diagnostic types (based on DSM-5 criteria); 2) to examine gender-related differences among patients with ED with or without both current FA and lifetime problematic SU; 3) to investigate whether clinical, psychopathological, impulsive, and personality characteristics are associated with FA and/or SU phenotypes; and 4) to identify relevant factors related to the presence of current FA and/or lifetime problematic SU in patients with EDs.

MATERIAL AND METHODS

Participants

The whole sample consisted of 527 patients with specific EDs (176 BN, 115 BED, and 236 OSFED) consecutively admitted to the EDs Unit of the Bellvitge University Hospital (Barcelona, Spain) between May 2016 and October 2020. The diagnoses were made according to DSM-5 criteria (American Psychiatric Association, 2013) by experienced clinical psychologists and psychiatrists specialized in EDs. Figure S1 (supplementary material) includes a flowchart summarizing the sampling process used in the inclusion of participants.

Assessment

Sociodemographic and clinical data were obtained by means of a face-to-face semi-structured interview based on the SCID-5 (First, Williams, Karg, & Spitzer, 2015). During this clinical interview, data on lifetime SU were also retrieved from specific questions based on Module E of the SCID-5 (First et al., 2015). Having problematic SU was defined as patterns of substance use (alcohol and/or illicit drugs) in an amount, frequency, or circumstance that is potentially physically, mentally, and socially harmful to the individual, regardless of whether the individual met full diagnostic criteria for SUD. Due to the high prevalence tobacco use was excluded from the category of “problematic SU” used in this study and, therefore, from all subsequent analyses, because its use was typically continuous, and because there is a high prevalence of smoking in the population of EDs.

Additionally, a comprehensive battery composed of commonly applied questionnaires in the field of EDs was administered:

Eating Disorders Inventory-2 (EDI-2) (Garner, 1991); Spanish validation (Garner, 1998). The EDI-2 assesses

different ED-related psychopathological characteristics, such as: drive for thinness, body dissatisfaction, bulimia, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. For the current sample, the internal consistency was excellent for the EDI-2 total score ($\alpha = 0.95$), and also satisfactory for all the subscales, ranging from $\alpha = 0.70$ for asceticism to $\alpha = 0.87$ for body dissatisfaction (see Cronbach’s alphas of all subscales in supplementary Table S1).

Symptom Checklist-90 Items-Revised (SCL-90-R) (Derogatis, 1990); Spanish validation (Derogatis, 1994). The SCL-90-R assesses nine scales on general psychopathology: somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. In addition, it assesses three global indices of psychological distress: Global Severity Index (GSI), Positive Symptom Total (PST), and Positive Symptom Distress Index (PSDI). The internal consistency was excellent in our sample for the GSI score ($\alpha = 0.98$), and also satisfactory for all the subscales, ranging from good ($\alpha = 0.75$ for paranoid ideation) to excellent ($\alpha = 0.90$ for depression) (see Cronbach’s alphas of all subscales in supplementary Table S1).

Temperament and Character Inventory-Revised (TCI-R) (Cloninger, 1999); Spanish validation (Gutiérrez-Zotes et al., 2004). The TCI-R contains 240 items for measuring personality traits structured into seven personality dimensions: four temperamental (novelty seeking, harm avoidance, reward dependence, and persistence) and three characters (self-directedness, cooperativeness, and self-transcendence) dimensions. Cronbach’s alpha for the current sample was good ($\alpha = 0.79$ for novelty-seeking) to excellent ($\alpha = 0.90$ for harm avoidance and persistence) (see Cronbach’s alphas of all subscales in supplementary Table S1).

Yale Food addiction Scale 2.0 (YFAS 2.0) (Gearhardt, Corbin, & Brownell, 2016); Spanish validation (Granero et al., 2018). This is a self-reported scale to assess FA based on the 11 substance dependence-related symptoms adapted to the context of food consumption. The YFAS 2.0 consists of 35 items and produces two measurements: (1) a continuous symptom count score that reflects the number of fulfilled diagnostic criteria (ranging from 0 to 11), and (2) a binary measurement (present versus absent) based on the number of symptoms (at least 2) and the self-reported clinically impairment or distress. Additionally, it gives severity cut-offs: mild (2–3 symptoms), moderate (4–5 symptoms), and severe (6–11 symptoms). The internal consistency of our sample was excellent ($\alpha = 0.965$).

The UPPS-P Impulsivity Scale (UPPS-P) (Whiteside, Lynam, Miller, & Reynolds, 2005); Spanish validation (Verdejo-García, Lozano, Moya, Alcázar, & Pérez-García, 2010). This questionnaire includes 59 items developed for assessing five impulsivity factors: lack of perseverance, lack of premeditation, sensation seeking, negative urgency, and positive urgency. The internal consistency in our sample was satisfactory for all the subscales, ranging from $\alpha = 0.83$ for lack of perseverance to $\alpha = 0.91$ for positive urgency (see Cronbach’s alphas of all subscales in supplementary Table S1).



Statistical analyses

Statistical analysis was carried out with Stata16 for Windows (Stata-Corp & StataCorp, 2019). Comparison between the groups was done with chi-square tests (χ^2) for categorical variables and with analysis of variance (ANOVA) for quantitative variables. Effect size for the mean differences in the psychometric tools was estimated through the standardized Cohen's-*d* coefficient, considering small effect as $|d| > 0.20$, mild-moderate as $|d| > 0.50$, and large-high as $|d| > 0.80$. Correction in Type-I error due to the multiple statistical significance tests was based on Finner's method, a familywise error procedure which has proved higher power than classical Bonferroni method (Finner & Roters, 2001).

Logistic regression was used to obtain a predictive model for the presence of current FA with lifetime SU (excluding tobacco), considering as potential predictors sociodemographic variables (gender, age, and marital status), age of onset of the ED, ED severity (EDI-2 total), general psychopathology (SCL-90R GSI), impulsivity levels (UPPS-P scales), and personality traits (TCI-R scales). In addition, two predictive models were conducted: the first one within the SU+ subsample (considering the presence of FA+ as criterion) and the next one within the FA+ subsample (considering the presence of SU+ as criterion). A stepwise procedure was used to automatically select the predictors achieving statistical significance ($P < 0.05$). Goodness-of-fit was tested with Hosmer-Lemeshow test (adequate fitting was considered for $P > 0.05$). Global predictive capacity was measured with Nagelkerke's pseudo- R^2 coefficient and global discriminative accuracy with the area under the ROC curve (AUC).

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The Clinical Research Ethics Committee of Bellvitge University Hospital approved the study. Written informed consent was obtained from all participants before taking part in the study.

RESULTS

Sample description

Most participants in the study were female ($n = 489$, 92.8%), single ($n = 368$, 69.8%), employed ($n = 291$, 55.3%), and had completed primary or secondary education ($n = 445$, 84.4%). Mean age was 32.1 years old ($SD = 12.6$), mean age of onset of ED was 20.4 years old ($SD = 9.9$), and mean duration of the ED was 12.0 years ($SD = 10.1$). Table 1 contains the descriptive for the ED subtypes and the comparison between the groups. Statistical differences were observed for marital status and employment status: the highest proportion of single participants was observed for OSFED followed by BN and BED, whereas the highest proportion of employed individuals was reported by BED, followed by BN and OSFED. Patients in the BED group also

reported the oldest age, the latest onset of the ED, and the longest duration of the disorder. As expected, the highest BMI mean was registered for BED, followed by BN and OSFED.

Prevalence of current FA and lifetime problematic SU

A total of 414 patients screened positive for FA (FA+) (prevalence = 78.6%). Lifetime problematic SU (SU+) was identified in $n = 144$ patients (prevalence = 27.3%) [alcohol use was reported by $n = 57$ (10.8%) and other illicit drugs by $n = 124$ (23.5%)]. The condition of FA+ and SU+ was present in $n = 125$ participants (23.7%).

Table 2 includes the prevalence of FA and lifetime problematic SU within the ED subtypes and the comparison between the groups. FA+ screening score achieved the highest prevalence among BN (93.2%) followed by BED (82.6%), and OSFED (65.7%). No statistical differences were obtained for SU+ (alcohol or illicit drugs) comparing the ED diagnoses. Further, patients with FA+ were more likely to present with SU+ (30.2%) than patients without FA (16.8%) ($\chi^2 = 8.00$, $P = 0.005$). The FA- and SU- phenotype was more likelihood within OSFED patients (28.0%), followed by BED (16.5%) and BN (5.1%). The FA+ and SU+ phenotype obtained the highest likelihood for BN (31.8%), followed by BED (21.7%) and OSFED (18.6%). No significant differences between both BED and OSFED were observed. The OSFED subtype displayed the lowest proportion for FA+ and SU+, but the highest proportion of FA- and SU+.

Association between gender with current FA and lifetime problematic SU

Within the subsample of women, FA- and SU- was observed in $n = 84$ (17.2%), FA+ and SU- in $n = 273$ (55.8%), FA- and SU+ in $n = 18$ (3.7%), and FA+ and SU+ in $n = 114$ (23.3%). Within the male subsample, FA- and SU- was observed in $n = 10$ (26.3%), FA+ and SU- in $n = 16$ (42.1%), FA- and SU+ in $n = 1$ (2.6%), and FA+ and SU+ in $n = 11$ (28.9%). No differences between gender were obtained for the distribution of FA and lifetime SU ($P = 0.328$).

Comparison of clinical profiles

Table 3 displays the distribution of the ED symptomatology (EDI-2 scales), the psychopathological state (SCL-90R scales), the impulsivity levels (UPPS-P scales), and the personality traits (TCI-R scales), as well as the comparison between the groups defined by the presence-absence of FA and lifetime SU. Overall, the condition characterized by FA- and SU- was associated with the lowest scores on ED severity and psychopathology, impulsivity, harm avoidance, and the highest self-directedness. The condition FA- and SU- also presented lower novelty seeking compared with FA+ and SU+. The comorbid condition of FA+ and SU+ obtained higher mean scores on the EDI-2 impulse regulation subscale, on the UPPS-P scales (except for lack of





Table 1. Descriptive of the sample

	Total		BN		BED		OSFED		P	BN versus BED		BN versus OSFED		BED versus OSFED		
	N = 527		N = 176		N = 115		N = 236			P	P	C-V	P	C-V	P	C-V
	n	%	n	%	n	%	n	%								
Gender																
Female	489	92.8%	167	94.9%	102	88.7%	220	93.2%	0.129	0.051	0.094	0.484	0.035	0.148	0.077	
Male	38	7.2%	9	5.1%	13	11.3%	16	6.8%								
Marital status																
Single	368	69.8%	122	69.3%	56	48.7%	190	80.5%	0.001*	0.001*	0.222[†]	0.032*	0.130[†]	0.001*	0.337[†]	
Married - partner	106	20.1%	34	19.3%	44	38.3%	28	11.9%								
Divorced - separated	53	10.1%	20	11.4%	15	13.0%	18	7.6%								
Education																
Primary	221	41.9%	67	38.1%	52	45.2%	102	43.2%	0.248	0.281	0.093	0.070	0.095	0.844	0.031	
Secondary	224	42.5%	73	41.5%	47	40.9%	104	44.1%								
University	82	15.6%	36	20.5%	16	13.9%	30	12.7%								
Employment																
Unempl.	104	19.7%	37	21.0%	26	22.6%	41	17.4%	0.001*	0.046*	0.146[†]	0.001*	0.195[†]	0.001*	0.301[†]	
Student	132	25.0%	34	19.3%	10	8.7%	88	37.3%								
Employed	291	55.3%	105	59.7%	79	68.7%	107	45.3%								
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>P</i>	<i>P</i>	<i> d </i>	<i>P</i>	<i> d </i>	<i>P</i>	<i> d </i>	
Age (years-old)	32.06	12.60	31.73	11.31	39.35	12.70	28.75	12.05	0.001*	0.001*	0.63[†]	0.013*	0.25	0.001*	0.86[†]	
Onset ED (years-old)	20.35	9.90	19.53	9.24	24.41	11.87	18.97	8.79	0.001*	0.001*	0.51[†]	0.566	0.06	0.001*	0.52[†]	
Duration ED (years)	11.97	10.09	12.58	9.38	15.39	11.23	9.86	9.55	0.001*	0.018*	0.27	0.006*	0.29	0.001*	0.53[†]	
BMI (kg m ⁻²)	28.06	9.49	26.46	6.16	40.28	9.42	23.31	5.71	0.001*	0.001*	1.74[†]	0.001*	0.53[†]	0.001*	2.18[†]	

Note. BN: bulimia nervosa. BED: binge eating disorder. ED: eating disorder. OSFED: other specified feeding or eating disorder.

SD: standard deviation. C-V: Cramer-V coefficient.

*Bold: significant parameter.

[†]Bold: effect size into the range mild-moderate to large-high.

Table 2. Prevalence of FA and/or lifetime problematic SU in EDs

	Total		BN		BED		OSFED		BN versus BED			BN versus OSFED			BED versus OSFED			
	N = 527		n = 176		n = 115		n = 236		BED		OSFED		OSFED		OSFED		OSFED	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
FA+	414	78.6%	164	93.2%	95	82.6%	155	65.7%	0.001*	0.165[†]	0.001*	0.325[†]	0.001	0.176				
SU	144	27.3%	59	33.5%	26	22.6%	59	25.0%	<i>P</i>	0.097	0.058	0.093	0.624					
Alcohol or drugs	57	10.8%	25	14.2%	10	8.7%	22	9.3%	0.069	0.083	0.123	0.076	0.848					
Alcohol	124	23.5%	50	28.4%	22	19.1%	52	22.0%	0.204	0.095	0.138	0.073	0.531					
illicit drugs	94	17.8%	9	5.1%	19	16.5%	66	28.0%	0.145	0.206[†]	0.001*	0.331[†]	0.006*					
FA and/or SU	289	54.8%	108	61.4%	70	60.9%	111	47.0%	0.001*	0.189[†]	0.001*	0.293[†]	0.019*					
FA+ and SU-	19	3.3%	3	1.7%	1	0.9%	15	6.4%	0.933	0.005	0.004*	0.142[†]	0.015*					
FA- and SU+	125	23.7%	56	31.8%	25	21.7%	44	18.6%	0.550	0.035	0.022*	0.113[†]	0.021*					
FA+ and SU+									0.041*	0.110[†]	0.002*	0.152[†]	0.493					

Note. FA: food addiction. FA-: food addiction negative screening score. FA+: food addiction positive screening score. SU-: lifetime substance use. SU+: lifetime substances use absent. SU+: lifetime substances use present. BN: bulimia nervosa. BED: binge eating disorder. OSFED: other specified feeding or eating disorder. C-V: Cramer-V coefficient.

Italic font: pairwise comparison for each level of the variable.

*Bold: significant parameter.

[†]Bold: effect size into the range mild-moderate to large-high.

premeditation and positive urgency), and on the TCI-R novelty seeking, as well as lower scores on the TCI-R self-directedness and cooperativeness scales.

In addition, Table S2 (supplementary material) shows the results of the comparison between the different types of problematic SU (i.e., alcohol and other illicit drugs) among patients with FA+. Overall, patients with FA+ and lifetime consumption of both alcohol and other illicit drugs presented higher ED symptomatology (EDI-2 total) and general psychopathology (SCL-90R GSI), as well as higher scores on positive urgency and novelty-seeking, and lower scores on self-directedness than those who had used a single type of substance (i.e., alcohol or illicit drugs).

Predictive model for the presence of current FA and lifetime problematic SU

The upper part of Table 4 shows the results of the stepwise logistic regression obtained for the whole sample (n = 527) considering the presence of FA+ and SU+. The likelihood of FA+ and SU+ was increased for unmarried or older patients or those with higher scores in novelty-seeking or lower scores in self-directedness. This model achieved adequate fitting (P = 0.522 in the Hosmer-Lemeshow test), but the global predictive capacity and the discriminative capacity were low (Nagelkerke's-R² = 0.112 and AUC = 0.684).

The middle part of Table 4 shows the result of an additional stepwise logistic regression obtained in the subsample of patients who reported SU+ (n = 144) considering as criterion the presence of FA+. Results showed that FA+ increased likelihood for patients with higher levels in ED severity, negative urgency and cooperativeness, and lower levels in reward dependence and self-directedness. This model also achieved adequate goodness-of-fit (P = 0.957 in the Hosmer-Lemeshow test), and good global predictive capacity and discriminative capacity (Nagelkerke's-R² = 0.334 and AUC = 0.843).

The lower part of Table 4 shows a final stepwise logistic model, obtained within the subsample that reported the presence of FA+ (n = 414, considering as the criterion the presence of SU+). The predictors increasing the likelihood for the consumption of substances were marital status (being unmarried), higher levels of novelty-seeking, and lower levels of cooperativeness. Adequate fitting was achieved for this model (P = 0.502 in Hosmer-Lemeshow test), but low predictive capacity (Nagelkerke's-R² = 0.079) and low discriminative capacity (AUC = 0.640).

DISCUSSION

The current study aimed to investigate the prevalence of current FA and/or lifetime problematic SU (except for tobacco) among patients with BN, BED, and OSFED. Likewise, the clinical, psychopathological, and personality profiles exhibited by the different addictive behaviors based on phenotypes were also examined. The main findings derived



Table 3. Comparison of the clinical profiles in the study

	FA– and SU–		FA+ or SU+		FA+ and SU+		FA– and SU–		FA– and SU–		FA+ or SU+				
	<i>n</i> = 94		<i>n</i> = 308		<i>n</i> = 125		<i>versus</i>		<i>versus</i>		<i>versus</i>				
	Mean	SD	Mean	SD	Mean	SD	FA+ or SU+	<i>P</i>	<i> d </i>	FA+ and SU+	<i>P</i>	<i> d </i>	FA+ and SU+	<i>P</i>	<i> d </i>
<i>ED severity (EDI-2)</i>															
Drive for thinness	11.19	6.55	15.27	4.80	15.60	4.99	0.001*	0.71 [†]	0.001*	0.76 [†]	0.545	0.07			
Body dissatisfaction	14.79	8.65	18.60	6.98	18.38	7.19	0.001*	0.49 [†]	0.001*	0.45	0.770	0.03			
Interceptive awareness	8.16	6.44	13.26	6.51	14.06	7.17	0.001*	0.79 [†]	0.001*	0.87 [†]	0.258	0.12			
Bulimia	3.65	4.18	8.96	5.15	9.29	5.23	0.001*	1.13 [†]	0.001*	1.19 [†]	0.543	0.06			
Interpersonal distrust	4.91	4.56	6.21	5.13	6.30	4.83	0.027*	0.27	0.041	0.30	0.855	0.02			
Ineffectiveness	8.33	6.58	12.53	7.28	12.98	7.60	0.001*	0.61 [†]	0.001*	0.65 [†]	0.557	0.06			
Maturity fears	7.96	4.66	8.60	5.75	9.24	6.39	0.339	0.12	0.102	0.23	0.296	0.10			
Perfectionism	4.76	3.90	6.36	4.49	6.39	4.52	0.002*	0.38	0.007	0.39	0.952	0.01			
Impulse regulation	4.61	4.98	6.91	5.63	9.06	7.29	0.001*	0.43	0.001*	0.71 [†]	0.001*	0.33			
Ascetism	5.20	3.74	7.90	3.77	8.32	4.41	0.001*	0.72 [†]	0.001*	0.76 [†]	0.317	0.10			
Social insecurity	6.47	5.11	8.39	5.13	8.92	5.26	0.002	0.38	0.001*	0.47	0.333	0.10			
Total score	80.0	39.0	113.0	37.9	118.6	42.6	0.001*	0.86 [†]	0.001*	0.94 [†]	0.183	0.14			
<i>Psychop. (SCL-90R)</i>															
Somatization	1.31	0.88	1.95	0.86	2.09	0.92	0.001*	0.73 [†]	0.001*	0.86 [†]	0.130	0.16			
Obsessive-compulsive	1.45	0.94	2.12	0.80	2.11	0.81	0.001*	0.77 [†]	0.001*	0.76 [†]	0.951	0.01			
Interpersonal sensitivity	1.56	1.01	2.15	0.85	2.18	0.95	0.001*	0.63 [†]	0.001*	0.64 [†]	0.686	0.04			
Depressive	1.67	0.94	2.43	0.83	2.51	0.88	0.001*	0.86 [†]	0.001*	0.93 [†]	0.387	0.09			
Anxiety	1.14	0.82	1.80	0.83	1.96	0.95	0.001*	0.79 [†]	0.001*	0.92 [†]	0.070	0.19			
Hostility	0.79	0.84	1.38	0.91	1.56	1.04	0.001*	0.68 [†]	0.001*	0.82 [†]	0.071	0.18			
Phobic anxiety	0.66	0.77	1.14	0.90	1.30	1.04	0.001*	0.58 [†]	0.001*	0.70 [†]	0.101	0.16			
Paranoia	1.15	0.78	1.53	0.84	1.59	0.88	0.001*	0.46	0.001*	0.53 [†]	0.478	0.07			
Psychotic	0.85	0.65	1.46	0.71	1.51	0.80	0.001*	0.89 [†]	0.001*	0.90 [†]	0.484	0.07			
GSI	1.26	0.72	1.89	0.66	1.98	0.77	0.001*	0.90 [†]	0.001*	0.97 [†]	0.193	0.13			
PST	51.6	20.32	67.3	14.65	68.2	16.26	0.001*	0.89 [†]	0.001*	0.90 [†]	0.616	0.06			
PSDI	2.06	0.58	2.46	0.52	2.53	0.58	0.001*	0.72 [†]	0.001*	0.80 [†]	0.213	0.13			
<i>Impulsivity (UPPS-P)</i>															
Lack premeditation	22.7	4.93	24.0	5.93	25.2	5.89	0.060	0.23	0.002*	0.45	0.058	0.20			
Lack perseverance	21.7	5.43	23.5	5.14	24.8	5.85	0.004*	0.34	0.001*	0.55 [†]	0.025*	0.23			
Sensation seeking	26.1	8.22	25.6	8.05	27.7	7.86	0.568	0.07	0.165	0.19	0.016*	0.26			
Positive urgency	26.8	8.33	28.8	8.57	31.1	9.73	0.047*	0.25	0.001*	0.48 [†]	0.014*	0.25			
Negative urgency	30.1	7.23	34.5	6.35	35.7	5.82	0.001*	0.64 [†]	0.001*	0.85 [†]	0.066	0.20			
<i>Personality (TCI-R)</i>															
Novelty seeking	97.2	14.39	100.1	15.41	105.9	17.51	0.121	0.19	0.001*	0.54 [†]	0.001*	0.35			
Harm avoidance	110.8	20.81	119.8	19.93	121.7	20.05	0.001*	0.44	0.001*	0.53 [†]	0.372	0.10			
Reward dependence	102.8	16.81	100.0	16.09	98.9	17.01	0.154	0.17	0.085	0.23	0.524	0.07			
Persistence	109.0	19.81	108.6	21.39	105.6	21.66	0.884	0.02	0.252	0.16	0.189	0.14			
Self-directedness	125.6	19.20	113.6	20.31	107.0	19.75	0.001*	0.61 [†]	0.001*	0.96 [†]	0.002*	0.33			
Cooperativeness	133.0	17.47	134.3	16.63	129.9	16.48	0.500	0.08	0.170	0.18	0.012*	0.27			
Self-transcendence	63.7	15.64	66.1	15.48	66.2	15.22	0.204	0.15	0.236	0.16	0.910	0.01			

Note. FA–: food addiction negative screening score. FA+: food addiction positive screening score.

SU–: lifetime substances use disorders absent. SU+: lifetime substances use disorders present.

*Bold: significant parameter.

[†]Bold: effect size into the range mild-moderate ($|d| > 0.50$) to large-high ($|d| > 0.80$).

from this study suggest that patients with at least one addictive-related behavior exhibited a more severe clinical state compared to those who reported none. Interestingly, the patients with the SU+ and FA+ phenotype did not show greater clinical severity than those with a single addiction, although they did show greater impulsivity and less self-directedness compared to the latter. Therefore, our findings suggest that, although presenting an addictive behavior is associated with greater ED symptomatology and general psychopathology, an additive effect of both addictive-like behaviors could not be evidenced. However, these findings should be interpreted cautiously due to the low sample size

of the FA– and SU+ groups (because of the high rates of FA in the ED population).

First, our results confirmed the high prevalence of FA in a sample of patients with EDs (78.6%) (Fauconnier et al., 2020; Jimenez-Murcia et al., 2019; Khalil et al., 2020; Romero et al., 2019). In agreement with previous literature (Gearhardt et al., 2014; Granero et al., 2018; Jimenez-Murcia et al., 2019), our results confirmed the higher prevalence of FA+ in the BN group, followed by the BED and OSFED groups. In this regard, a prior study suggested that FA may reflect the increased psychopathology of BN patients (Gearhardt et al., 2014). Regarding lifetime problematic SU,



Table 4. Predictive model for the presence of FA+ and SU+: stepwise logistic regression

Complete sample (n = 527)	B	SE	P	OR	95%CI	OR
Marital status (married)	−0.898	0.323	0.005	0.407	0.216	0.767
Age (years-old)	0.018	0.009	0.048	1.018	1.000	1.037
TCI-R novelty seeking	0.022	0.007	0.001	1.023	1.009	1.036
TCI-R self-directedness	−0.022	0.006	<0.001	0.978	0.967	0.989
<i>Fitting indexes</i>	Hosmer and Lemeshow test: $\chi^2 = 7.138$; $df = 8$; $P = 0.522$ Nagelkerke's pseudo-R ² : 0.112 Area under the ROC curve: 0.684 (95%CI: 0.631–0.738)					
Subsample: SU+ (n = 144)	B	SE	P	OR	95%CI	OR
ED severity	0.025	0.009	0.007	1.025	1.007	1.044
UPPS-P negative urgency	0.118	0.050	0.018	1.125	1.020	1.241
TCI-R reward dependence	−0.042	0.020	0.036	0.959	0.923	0.997
TCI-R cooperativeness	0.052	0.023	0.023	1.053	1.007	1.101
TCI-R self-directedness	−0.041	0.020	0.038	0.960	0.923	0.998
<i>Fitting indexes</i>	Hosmer and Lemeshow test: $\chi^2 = 2.595$; $df = 8$; $P = 0.957$ Nagelkerke's pseudo-R ² : 0.334 Area under the ROC curve: 0.843 (95%CI: 0.751–0.934)					
Subsample: FA+ (n = 414)	B	SE	P	OR	95%CI	OR
Marital status (married)	−0.764	0.300	0.011	0.466	0.259	0.840
TCI-R novelty seeking	0.022	0.007	0.002	1.022	1.008	1.036
TCI-R cooperativeness	−0.014	0.007	0.038	0.986	0.974	0.999
<i>Fitting indexes</i>	Hosmer and Lemeshow test: $\chi^2 = 7.326$; $df = 8$; $P = 0.502$ Nagelkerke's pseudo-R ² : 0.079 Area under the ROC curve: 0.640 (95%CI: 0.582–0.697)					

Note. SE: standard error. OR: odds ratio. SU+: lifetime substances use disorders present.

Predictors entered in the stepwise procedure: sociodemographic (gender, marital status), age, age of onset of the ED, ED severity (EDI-2 total), psychopathology distress (SCL-90R GSI), impulsivity level (UPPS-P scales), and personality traits (TCI-R scales).

our results were not able to find statistical differences across ED diagnostic types for neither alcohol nor illicit drugs. This finding is inconsistent with previous studies describing higher frequencies of SU+ in patients with BN compared to other ED diagnoses (Fouladi et al., 2015; Nøkleby, 2012). However, it is in line with other studies suggesting that individuals presenting binge eating and/or purging behaviors are more susceptible to engage in SU+, independent of ED diagnostic type (Bahji et al., 2019; Lozano-Madrid et al., 2020). Further, our results showed a prevalence of presenting with both addictive-like behaviors (i.e., FA+ and SU+) in almost 24% of the ED participants. In addition, our findings suggest that patients with FA+ may be more likely to present with SU+ than those without FA.

On the other hand, patients with ED and FA+ and/or SU+ did not show significant gender-related differences. Similarly, previous studies screening FA were not able to find gender differences among participants with ED (Granero et al., 2014; Wolz, Granero, & Fernández-Aranda, 2017). In the same vein, a study in general populations failed to find sex differences in the prevalence of FA+ (Wu, Zimmer, Munn-Chernoff, & Baker, 2020). Likewise, when exploring gender differences in patients with ED and SU+, our findings are in line with other studies that failed to find gender differences (Lozano-Madrid et al., 2020). However, Becker and Grilo (2015) observed a higher proportion of men with BED and comorbid SUD compared to those without SUD. Findings

related to gender-related differences should be cautiously considered because there is an underrepresentation of males in current literature, due to the low proportion of them in routine clinical practice (Bahji et al., 2019). Therefore, future studies focusing on gender-related differences should consider the inclusion of a larger sample of males to get a better understanding.

Concerning clinical and psychopathological characteristics, our findings support prior evidence suggesting that the presence of addictive-related behaviors (i.e., FA+ or SU+ or both) is associated with more severe ED symptomatology, general psychopathology, and emotional dysregulation in the general (Hardy et al., 2018; Wiedemann, Carr, Ivezaj, & Barnes, 2021) and clinical populations (Romero et al., 2019; Tingham et al., 2021). Specifically for FA, several studies have identified the presence of FA as a severity marker in ED, in patients with binge eating and/or purging behaviors (Brewerton, 2017; Carter, Van Wijk, & Rowsell, 2019; Jimenez-Murcia et al., 2019; Romero et al., 2019), but also in those with AN-R (Fauconnier et al., 2020; Tran et al., 2020). On the other hand, our results were not able to show that patients with both addictive-related behaviors (i.e., FA+ and SU+) presented with a more severe clinical condition than patients with a single comorbid addiction. Although we expected to find that the FA+ and SU+ phenotype would also be the most severe, we were not able to determine the additive effect of FA and lifetime SU. However, these findings reinforce the need to explore and treat the comorbidity



of addictive behaviors in these patients, regardless of whether they have one or more addictive behaviors.

In terms of personality and impulsivity, patients with at least one comorbid addictive condition (i.e., FA+, SU+, or both) were more likely to have a dysfunctional personality profile characterized by higher harm avoidance and lower self-directedness, as well as greater impulsivity than patients without addictive behaviors. These impairments in impulse control in patients with EDs and comorbid addictive behaviors had already been described by previous studies (Dawe & Loxton, 2004; Minhas et al., 2021). Specifically, negative urgency, defined as the tendency to rashly act under strong emotions (Cyders & Smith, 2008), was the impulsive trait most strongly related to the presence or absence of at least one addiction-related behavior. This result is consistent with a previous study suggesting that negative urgency may be a predictor of FA+ in patients with EDs (Wolz et al., 2017) and that it may play a key role as a risk factor to treatment success in patients with SUD (Halcomb, Argyriou, & Cyders, 2019).

Furthermore, our findings identified that patients with both addictive behaviors (i.e., FA+ and SU+) showed a lower self-directedness and a greater exacerbation of the impulsive traits (namely, higher lack of perseverance, sensation seeking, and positive urgency) even than those with only FA+ or SU+. Hence, this relevant finding suggests that these impulsivity traits and the lack of self-determination could act as a differentiating risk factor for developing more than one co-morbid addictive-related behavior in patients with EDs.

When we specifically considered the types of problematic SU (i.e., alcohol or other illicit drugs) in patients with FA+, it was observed that patients with FA who had consumed both alcohol and other illicit drugs in their lifespan exhibited more ED-related and psychopathological severity, higher positive urgency and novelty-seeking traits, and lower self-directedness than those who had used a single type of substance. This finding is consistent with previous research studies suggesting an additive effect of multiple addictive patterns associated with a poor clinical state and increased impulsivity (Jimenez-Murcia et al., 2021; Martínez-Loredo, Macipe, ErrastiPérez, & Al-Halabí, 2021).

Finally, some sociodemographic variables such as being older and unmarried were associated with a higher likelihood of presenting with the FA+ and SU+ phenotype. These findings are in line with previous studies carried out in other populations that have addictions (Del Pino-Gutiérrez et al., 2017). This may suggest a protective effect of marriage in substance use and abuse (Choe, Yoo, JeKarl, & Kim, 2018; Jimenez-Murcia et al., 2017; Kendler, Lönn, Salvatore, Sundquist, & Sundquist, 2016). Furthermore, as expected, high scores on novelty seeking and low scores on self-directedness were strongly associated with the FA+ and SU+ phenotype. Specifically, for patients with SU+, the presence of comorbid FA+ was associated with increased ED severity and negative urgency, and less reward dependence and self-directedness. Likewise, for patients with FA+, the presence of SU+ was associated with higher novelty

seeking and lower cooperativeness (i.e., more self-centered and less willing to have social relationships with other people). These personality traits have previously been identified as possible risk factors for the development of addictive behaviors (Del Pino-Gutiérrez et al., 2017; Krug et al., 2009; Steingrímsson, Carlsen, Lundström, Lundström, & Nilsson, 2020) as well as with the presence of more than one addictive behavior (Dash et al., 2019).

Limitations and strengths

The present study should be considered within the context of some limitations. First, our results should be interpreted with caution, keeping in mind that they refer to patients with a history of problematic SU and not a full diagnosis of SUD. Second, the FA measure refers to current FA but the problematic SU measure refers to lifetime SU. Further studies should disentangle current vs. lifetime use for problematic SU, as well as assess lifetime FA. Third, our participants were recruited from a hospital setting and, in addition, patients with AN were not included because of the existing controversy as to whether they actually present with FA or their responses to the YFAS 2.0 items reflect their subjective fear of losing control with food. Therefore, our sample is not representative of the general ED population. Fourth, in this study we compared the characteristics of patients presenting at least one addictive behavior (i.e., FA+ or SU+) versus those presenting neither or both. It would be interesting for further research to analyze whether there are differences between the FA+ and SU- and the FA- and SU+ groups, which could not be analyzed in this study due to the low sample size of the FA- and SU+ groups. Also, further studies with large sample sizes might include tobacco use in the analysis of substance addiction. Finally, the cross-sectional design of our study does not allow us to draw inferences regarding causality.

Notwithstanding these limitations, the study also has several strengths that should be noted. To the best of our knowledge, this is the first study exploring FA and lifetime problematic SU, both jointly and separately, in a large sample of adult patients, including women as well as men with EDs.

CONCLUSIONS

In conclusion, our findings indicate that the presence of one or more addictive behaviors in patients with BN, BED, and OSFED was associated with increased ED severity. The difference between engaging in one or more lifetime addictive-like behaviors (i.e. FA and/or alcohol and/or or illicit drug use or both) was only reflected in personality traits, with greater impulsivity and less self-directedness in the FA+ and SU+ phenotype. Although further longitudinal studies assessing whether these addictive phenotypes may influence treatment outcome are needed, these findings may suggest the need for treatments to reduce impulsivity and increase self-directedness, especially in patients with this



greater addictive phenotype, as a step toward improving their treatment outcome.

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APPENDIX

Supplementary material

Table S1. Internal consistency in the sample (Cronbach's alpha)

TCI-R Novelty seeking	0.786	EDI-2: Drive for thinness	0.801	SCL-90R Somatization	0.891
TCI-R Harm avoidance	0.898	EDI-2: Body dissatisfaction	0.870	SCL-90R Obsessive	0.851
TCI-R Reward dependence	0.836	EDI-2: Interoceptive awareness	0.798	SCL-90R interpersonal Sensitivity	0.857
TCI-R Persistence	0.898	EDI-2: Bulimia	0.778	SCL-90R Depression	0.901
TCI-R Self-directedness	0.863	EDI-2: Interpersonal distrust	0.809	SCL-90R Anxiety	0.871
TCI-R Cooperativeness	0.848	EDI-2: Ineffectiveness	0.864	SCL-90R Hostility	0.851
TCI-R Self-transcendence	0.849	EDI-2: Maturity fears	0.772	SCL-90R Phobic anxiety	0.826
UPPS-P Lack premeditation	0.844	EDI-2: Perfectionism	0.714	SCL-90R Paranoid ideation	0.750
UPPS-P Lack perseverance	0.825	EDI-2: Impulse regulation	0.783	SCL-90R Psychoticism	0.811
UPPS-P Sensation seeking	0.869	EDI-2: Asceticism	0.701	SCL-90R GSI	0.976
UPPS-P Positive urgency	0.909	EDI-2: Social insecurity	0.773	SCL-90R PST	0.976
UPPS-P Negative urgency	0.828	EDI-2: Total score	0.945	SCL-90R PSDI	0.976
YFAS-2	0.965				

Table S2. Clinical profiles of patients with FA and SU

	FA & AL		FA & DR		FA & AL & DR		FA & AL		FA & AL		FA & DR	
	N = 18		N = 77		N = 30		vs FA & DR		vs FA & AL & DR		vs FA & AL & DR	
	Mean	SD	Mean	SD	Mean	SD	P	d	P	d	P	d
<i>ED severity (EDI-2)</i>												
Drive for thinness	14.44	5.91	15.38	5.13	16.87	3.77	0.475	0.17	0.104	0.51 [†]	0.166	0.33
Body dissatisfaction	20.00	7.34	17.64	7.62	19.30	5.79	0.211	0.32	0.744	0.11	0.284	0.25
Interoceptive awareness	15.56	7.49	13.13	7.12	15.53	6.93	0.196	0.33	0.992	0.00	0.120	0.34
Bulimia	10.17	5.01	8.21	5.25	11.53	4.59	0.142	0.38	0.368	0.28	0.003 *	0.67 [†]
Interpersonal distrust	5.22	2.90	6.01	4.99	7.70	5.17	0.530	0.19	0.086	0.59 [†]	0.105	0.33
Ineffectiveness	15.44	6.72	11.82	7.52	14.50	7.89	0.067	0.51 [†]	0.674	0.13	0.100	0.35
Maturity fears	10.56	7.56	8.52	5.78	10.30	7.06	0.225	0.30	0.893	0.03	0.197	0.28
Perfectionism	6.17	4.44	5.94	4.29	7.70	5.01	0.844	0.05	0.254	0.32	0.070	0.38
Impulse regulation	10.83	7.36	7.60	6.63	11.77	8.08	0.084	0.46	0.660	0.12	0.007 *	0.56 [†]
Ascetic	9.44	4.68	7.78	4.35	9.03	4.33	0.150	0.37	0.754	0.09	0.187	0.29
Social insecurity	8.44	4.31	8.60	5.30	10.03	5.64	0.912	0.03	0.313	0.32	0.207	0.26
Total score	126.3	42.85	110.6	42.00	134.3	40.23	0.154	0.37	0.522	0.19	0.010 *	0.57 [†]
<i>Psychop. (SCL-90R)</i>												
Somatization	2.34	0.91	1.94	0.92	2.34	0.88	0.092	0.44	0.995	0.00	0.040 *	0.45
Obsessive-compulsive	2.36	0.97	1.97	0.71	2.34	0.87	0.060	0.46	0.929	0.02	0.031 *	0.47
Interpersonal sensitivity	2.22	1.02	2.09	0.96	2.41	0.90	0.609	0.13	0.493	0.20	0.118	0.35
Depressive	2.78	0.90	2.37	0.86	2.70	0.87	0.079	0.46	0.764	0.09	0.084	0.38
Anxiety	2.18	0.98	1.78	0.96	2.29	0.84	0.102	0.42	0.693	0.12	0.012 *	0.57 [†]
Hostility	1.74	1.20	1.55	1.04	1.49	0.94	0.486	0.17	0.420	0.23	0.787	0.06
Phobic anxiety	1.52	1.13	1.23	1.03	1.36	0.99	0.276	0.27	0.591	0.16	0.560	0.13
Paranoia	1.61	0.95	1.44	0.86	1.97	0.80	0.446	0.19	0.161	0.41	0.005 *	0.64 [†]
Psychotic	1.66	0.88	1.37	0.81	1.79	0.67	0.170	0.34	0.569	0.17	0.015 *	0.57 [†]
GSI	2.17	0.84	1.85	0.76	2.21	0.69	0.109	0.40	0.855	0.05	0.029 *	0.50 [†]
PST	70.00	19.09	65.73	15.81	73.43	14.66	0.311	0.24	0.474	0.20	0.028 *	0.51 [†]
PSDI	2.69	0.59	2.45	0.58	2.64	0.56	0.111	0.42	0.763	0.09	0.128	0.33
<i>Impulsivity (UPPS-P)</i>												
Lack premeditation	24.83	5.22	24.92	5.62	25.97	6.98	0.954	0.02	0.522	0.18	0.414	0.16
Lack perseverance	24.94	5.08	24.65	6.39	25.07	4.91	0.849	0.05	0.945	0.02	0.743	0.07
Sensation seeking	25.78	5.04	27.34	8.14	29.63	8.33	0.448	0.23	0.101	0.56 [†]	0.176	0.28
Positive urgency	30.50	8.26	29.82	9.52	34.93	10.38	0.786	0.08	0.123	0.47	0.014 *	0.51 [†]
Negative urgency	34.94	5.60	35.44	5.99	36.87	5.54	0.745	0.09	0.271	0.35	0.258	0.25

(continued)



Table S2. Continued

	FA & AL		FA & DR		FA & AL & DR		FA & AL		FA & AL		FA & DR	
	N = 18		N = 77		N = 30		vs FA & DR		vs FA & AL & DR		vs FA & AL & DR	
	Mean	SD	Mean	SD	Mean	SD	P	d	P	d	P	d
<i>Personality (TCI-R)</i>												
Novelty seeking	102.1	21.81	104.3	17.53	112.1	13.09	0.625	0.11	0.054	0.56[†]	0.038*	0.50[†]
Harm avoidance	118.8	22.17	121.5	19.88	123.7	19.63	0.610	0.13	0.423	0.23	0.624	0.11
Reward dependence	98.7	17.81	99.2	17.73	98.1	15.04	0.900	0.03	0.917	0.03	0.766	0.07
Persistence	103.6	22.95	105.6	21.65	106.9	21.57	0.722	0.09	0.618	0.15	0.796	0.06
Self-directedness	103.4	21.68	110.7	20.22	99.6	14.83	0.149	0.35	0.511	0.20	0.008*	0.63[†]
Cooperativeness	131.9	22.10	129.6	15.29	129.4	16.08	0.599	0.12	0.611	0.13	0.949	0.01
Self-transcendence	68.1	16.87	64.2	13.02	70.4	18.66	0.326	0.26	0.617	0.13	0.061	0.38

Note. FA: food addiction present. AL: Alcohol disorder. DR: drugs disorder. SD: standard deviation.

*Bold: significant parameter. [†]Bold: effect size into the range mild-moderate ($|d| > 0.50$) to large-high ($|d| > 0.80$).

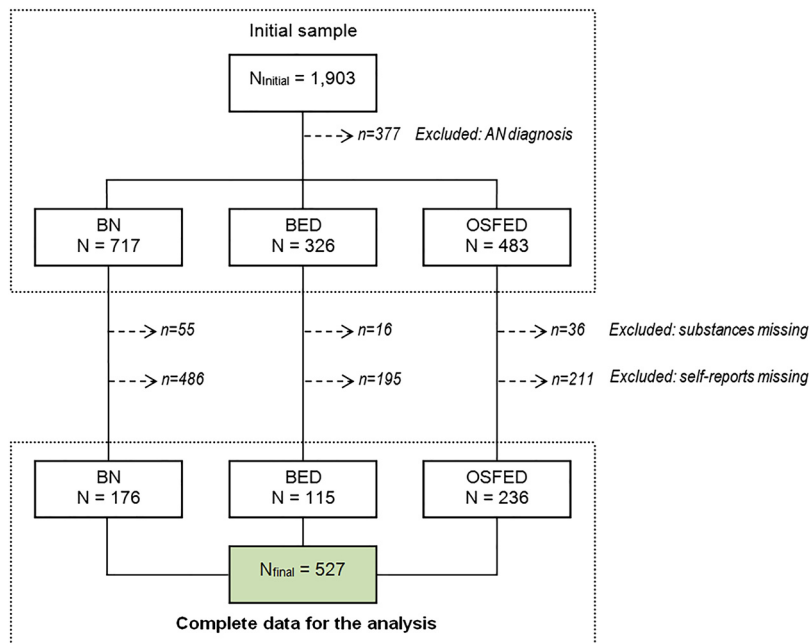


Fig. S1. Flow-chart with the sampling

Note. AN: anorexia nervosa. BN: bulimia nervosa. BED: binge eating disorder. OSFED: other specified feeding or eating disorder

