A cluster analysis of purging disorder: Validation analyses with eating disorder symptoms, general psychopathology and personality

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Abstract

Objectives: To assess the natural grouping of Purging Disorder (PD) patients based on purging symptomatology and to evaluate the derived classes a.) against each other and b.) to healthy controls (HC) on a range of clinical and psychological measures. A further aim was to relate the PD cluster solution to the DSM-5 severity index currently outlined for bulimia nervosa (BN). **Method:** Participants included 223 consecutively admitted women with PD to a tertiary ED treatment centre. Additionally, 822 HCs were recruited from the community. Purging behaviours (self-induced vomiting, laxative and diuretic use) were used as indicators., while the EDI-2 (ED symptoms), the SCL-90-R (general psychopathology) and the TCI-R (personality traits) were used as validators. **Results:** Three distinct PD clusters emerged: Cluster 1 (only self-induced vomiting), Cluster 2 (self-induced vomiting and laxative use) and Cluster 3 (all purging methods). Significant differences between Cluster 1 and Cluster 3 were found for the EDI-2 drive for thinness and perfectionism subscales, and the TCI-persistence scale. All clusters differed significantly from HCs on all the EDI-2 and the SCL-90-R scales, but findings for the TCI-R scales were less consistent. Finally, the three clusters mapped only to some extent onto the DSM-5 severity index for BN. **Conclusions:** Several noteworthy differences in ED and personality symptomatology emerged across the three derived PD clusters and the HC group. However, these findings need to be replicated using further taxometric approaches. Alternative methods to the DSM-5 severity index for assessing the severity of purging behaviours in PD are also warranted.

KEYWORDS

Classification, OSFED, personality, purging disorder, severity indicator

Introduction

Based on DSM-5 diagnostic criteria (APA, 2013), more than 50% of all ED patients are diagnosed as Other Specified Feeding or Eating Disorder (OSFED), a broad heterogeneous mixture of various eating disorder (ED) symptoms. One of the specific OSFED categories is Purging Disorder (PD), which is characterised by self-induced vomiting, misuse of laxatives or diuretics to control weight or shape, in the absence of binge eating episodes (APA, 2013). In treatment settings, prevalence rates have been found to vary from 3% at an inpatient facility (Dalle Grave & Calugi, 2007) to up to 24% (Binford & le Grange, 2005) in an outpatient ED treatment centre. In 2017, a meta-analysis of 38 eligible PD studies, revealed that PD occupies a space that falls between Anorexia Nervosa (AN) and Bulimia Nervosa (BN), 'not quite' one or the other (Smith, Crowther, & Lavender, 2017). Empirical classification studies have provided inconsistent results regarding PD as a distinct phenomenon, with some revealing a latent class bearing a resemblance to PD (e.g. Striegel-Moore et al., 2005; Swanson et al., 2014), whereas others refute this (e.g. Wade, Crosby, & Martin, 2006). However, to date, no study has assessed whether different clusters exist across a clinical PD sample. The current study, therefore, evaluated for the first time the natural grouping of PD patients, according to DSM-5 criteria, and compared these classes to each other and healthy controls (HCs).

Classification studies of purging disorder

In the PD literature, only a small amount of classification studies have been reported. These studies have generally yielded inconsistent findings regarding the uniqueness of PD, with some studies supporting a latent class resembling PD (e.g. Pinheiro, Bulik, Sullivan, & Machado, 2008; Striegel-Moore et al., 2005; Sullivan, Bulik, & Kendler, 1998), whereas others have failed to find such a distinction (e.g. Bulik, Sullivan, & Kendler, 2000; Keel et

al., 2004; Wade et al., 2006). For instance, Striegel-Moore and colleagues (2005), who assessed data from women with BN symptoms, provided support for a distinct PD group, which was characterised by frequent purging behaviours and negligible bingeing. Similarly, Mitchell and colleagues (2007), applied latent profile analysis (LPA) in their sample diagnosed with Eating Disorders Not Otherwise Specified (EDNOS), and also revealed a cluster characterised mainly by vomiting and laxative use. Conversely, results from Wade and colleagues (2006) failed to distinguish between women who purged and binged from women who purged without any associated objectively large binge episodes. Explanations for the inconsistent findings across the comparison and classification studies have centered on the lack of consensus regarding the description of PD and its relationship to the other EDs and various other methodological differences in samples and indicators included in the different analyses.

The importance of the severity index in the DSM-5

Researchers have argued that when evaluating the validity of a diagnostic category, such as PD, it is essential to consider both categorical differences in symptom topography as well as dimensional differences in severity (e.g. Keel, Crosby, Hildebrandt, Haedt-Matt, & Gravener, 2013; Koch, Quadflieg, & Fichter, 2013). The DSM-5 (APA, 2013) outlines a severity index for the official ED diagnoses, including AN, BN and Binge Eating Disorder (BED). BN is considered as the ED category mostly resembling PD, given the overlaps in purging behaviours and weight criteria (Riesco et al., 2018). The BN severity index is based on the frequency of inappropriate compensatory behaviours (i.e., self-induced vomiting, laxative use, diuretic use): mild (1–3 episodes per week), moderate (4–7 episodes per week), severe (8–13 episodes per week), and extreme (≥14 episodes per week). Clinical relevance of the BN severity specifiers has been obtained from studies assessing both clinical ED (e.g.

Dakanalis, Bartoli, et al., 2017; Dakanalis, Clerici, Riva, & Carra, 2017; Jenkins, Luck, Cardy, & Staniford, 2016) and nonclinical samples (e.g. Grilo, Ivezaj, & White, 2015). To our knowledge, no study has yet applied the BN severity specifiers for the purging behaviours in a PD sample and assessed its validity. This is significant as evidence for dimensional differences in PD would provide support for the validity of PD as a distinct diagnostic category.

Aims of the study

Taken together, the best classification of PD patients using taxometric statistical analyses has not yet been satisfactorily determined. To inform future research for classification systems (i.e. DSM-6) and offer a characterisation of PD that has clinical utility, the current study, therefore, aimed to assess for the first time the clinical significance and diagnostic validity of a large PD sample using cluster analyses.

The aims of the current study were threefold. Firstly, we aimed to explore natural groupings of PD patients on key diagnostic variables measuring the purging profile, including weekly frequency of vomiting, laxatives and diuretic misuse. Secondly, we assessed the validity of the final PD cluster solution, by comparing the derived clusters on a range of validator variables, including sociodemographics, general and ED-related psychopathology and personality. Thirdly, to explore the relevance of the PD clusters to established theoretical dimensional systems, the PD cluster solution was compared to the DSM-5 (APA, 2013) severity index for BN for purging behaviours (i.e., mild, moderate, severe, extreme). BN severity specifiers were chosen for this aim because the DSM-5 (APA, 2013) does not currently provide any specifiers for PD. The clinical significance of the PD clusters would be evidenced by significant differences between the PD clusters and the HC group on the assessed variables. We used the definition of PD currently outlined in the DSM-5 (APA,

2013) and most commonly used in the literature (e.g. Keel, 2007, 2019; Smith et al., 2017), which includes individuals who have used purging episodes (e.g., self-induced vomiting, laxative and/or diuretic misuse) in the absence of objectively large binge-eating episodes at least once per week, averaged over the past three months, to control their weight or shape and undue influence of weight or shape on their self-evaluation.

Method

Participants

The sample comprised 223 PD female patients presenting consecutively for treatment to the ED Unit within the Department of Psychiatry at Bellvitge University Hospital (Barcelona, Spain). A sample of healthy female volunteers (n = 822) with a body mass index between 18.5–24.9 kg/m^2, and no history of an ED were used for comparison purposes. Patients were diagnosed according to DSM-IV-TR criteria (APA, 2000), and diagnoses were re-analysed and re-codified post hoc using DSM-5 criteria (APA, 2013).

Exclusion criteria for all the participants were: (a) being male (due to the low prevalence in PD); and (b) being under 18 or over 50-year old. Furthermore, in the HC group, an additional exclusion criterion was having suffered from a lifetime ED. This was assessed using a self-reported screening instrument with closed-ended questions addressing core features for the diagnosis of ED based on DSM-5 criteria, (e.g. presence and frequency of binge eating episodes, vomits, laxative and diuretics misuse and weight loss, both in the last 3 months and lifetime).The mean age of the ED sample was 27.3 years (SD=9.7), and the mean age of the control was 22.52 (SD=5.65). The mean age of onset of the ED was 19.9 years (SD=7.6), and the mean duration of illness was 7.1 years (SD=7.0). The mean value for the weekly frequency for the different purging behaviours was 4.3 (SD=9.9) for vomiting, 3.5 (SD=10.7) for laxative use and 2.7 (SD=9.8) for diuretic use. Table 1 outlines the sociodemographic information for the PD groups obtained in the clustering and the control

samples. This table includes both the results of the global comparison between the empirical clusters, as well as the pairwise comparison of each cluster versus the control group. All sociodemographic variables differed significantly between the PD clusters and the control group, with the control group reporting to be younger, more frequently single, having completed secondary education and being more commonly employed.

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Measures

Eating Disorder Inventory-2 (EDI-2) (Garner, 1991; Spanish version: Garner, 1998)

This multidimensional self-report questionnaire includes 91 items to assess cognitive and behavioural characteristics related to EDs: drive for thinness, body dissatisfaction, bulimia, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. A global measure of ED severity can be obtained based on the sum of all the items on the scale. Internal consistency for EDI scales was good to excellent in our sample and ranged from 0.71 for the ascetic subscale to 0.97 for the total scale.

Temperament and Character Inventory-Revised (TCI-R) (Cloninger, 1999; Spanish version: Gutiérrez-Zotes, 2004)

This self-report questionnaire is designed to evaluate personality traits using 240-items on a five-level Likert scale. It is structured on seven primary personality dimensions: four temperamental factors (novelty seeking, harm avoidance, reward dependence and persistence) and three character dimensions (self-directedness, cooperativeness and self-transcendence). Cronbach's alpha for the TCI-R in the current study sample was adequate to excellent and ranged from 0.79 for novelty-seeking to 0.90 for harm avoidance.

Symptom Checklist-Revised (SCL-90-R)(Derogatis, 1990; Spanish version: Derogatis, 2002)

This 90-item self-report questionnaire is widely used for the measurement of psychopathology. It is structured on nine first-order dimensions: somatisation, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. The SCL-90-R also comprises the following summary scales; a positive symptom distress index (PSDI), designed to measure the intensity of symptoms as well as a positive symptom total (PST), which measures self-reported symptoms. The Global Severity Index (GSI) represents the severity of psychopathology symptoms across all domains. Internal consistency for SCL-90-R scales was between good to excellent in our sample and ranged from 0.80 for paranoid ideation to 0.98 to global scales.

Procedure

All ED participants were first assessed during a structured face-to-face interview [for further information, please refer to Fernandez-Aranda & Turon (1998)]. During the interview the clinical data were retrieved based on the SCID-I (First, Spitzer, Gibbon, & Williams, 2002) and from 2015 onwards the SCID-Clinical Version (First, Williams, Karg, & Spitzer, 2015) criteria. ED diagnoses were made using this information. All interviews were carried out by experienced psychologists. Further psychometric data were obtained from the ED patients using the above-mentioned self-report questionnaires. Participants in the HC group were recruited from the same university hospital setting to guarantee the equivalence of the geographical origin between study groups. The control group filled in all measures using a self-report questionnaire. The Ethics Committee of our institution approved the current study, and informed consent was obtained from all participants.

Statistical analysis

Statistical analyses were carried out with SPSS24 for Windows. Empirical groups were explored through a Two-step-cluster procedure using the PD sample (*n*=223). The indicator variables measured the purging profile: total number of purging episodes, presence of vomiting, laxatives and/or diuretics. The two-step-cluster method allows identifying natural groupings (clusters or classes) within datasets that would otherwise not be apparent. In the first step of the analyses, individuals are pre-clustered according to a sequential clustering approach into small sub-clusters. In contrast, during the second step, these sub-clusters are re-grouped into a final number of clusters according to the agglomerative hierarchical clustering method (the log-likelihood distance and the Schwarz Bayesian Information Criterion are employed in determining the optimal number of clusters, choosing a solution with a reasonably large ratio of Schwarz Bayesian Information Criterion changes and a large ratio of distance measures). The procedure uses the log-likelihood distance measure through a multinomial probability mass function for categorical variables and a standard density function for continuous variables. The algorithm used by the Two-step-cluster has desirable features, which make it different from traditional clustering and latent class techniques (Bacher, 2000): a.) handling of categorical and quantitative variables; b.) automatic selection of the number of clusters-classes (by comparing the values of a model-choice criterion across different grouping solutions) and c.) scalability, which allows analysing large data files by constructing a cluster-features-tree which is used as a summary of the records

The final model selected in this study was based on the following criteria (Nylund, Asparouhov & Muthén, 2007): a) adequate goodness-of-fit (based on a cohesion and separation index); b) appropriate clinical interpretability; and c) simple size for each group to guarantee statistical power. In this study, the Silhouettes coefficient (which estimate the

cohesion of the elements within a cluster and the separation between the clusters), was used as a measure of the goodness of the final cluster solution (this coefficient ranges from -1 to +1, being the values lower than 0.30 interpreted as poor fitting, between 0.30 and 0.50 as appropriate fitting and higher than 0.50 as good fitting (Rousseeuw, 1987).

The validity analysis of the final cluster solution was based on the comparison between the empirical clusters on sociodemographics and ED clinical data as well as the following measures: EDI-2, SCL-90-R and TCI-R. Additionally, empirical clusters were also compared with the HC sample. The comparison between the groups was based on chi-square tests (χ^2) for categorical variables and analysis of variance (ANOVA) for quantitative variables. The increase in Type-I error due to multiple statistical comparisons was done with Finner's method, a Familywise error rate stepwise procedure which offers a more robust test than the classical Bonferroni correction (Finner, 1993).

Results

Cluster composition

The final 3-cluster solution (chosen by the Two-step-cluster procedure) was selected as being the most optimal classification solution of the *n*=223 women who met criteria for PD. This solution obtained a Silhouettes index (0.70) in the good range, suggesting adequate evidence of cluster structure in the data. The comparison between the largest cluster size (*n*=121, 54.3%) and the smallest (*n*=47, 20.2%) yielded a ratio of 2.57.

Figure 1 represents the clustering procedure for this 3-cluster solution. The first figure contains the bar-graph with the indicators' relevance in the clustering procedure, which reports how well each variable can differentiate between the derived clusters (the higher the importance of the variable, the less likely it is that the variation for the variable between clusters is due to chance and the more likely it is expected to be because of the underlying differences). The indicator variable with the highest statistical, not clinical, contribution into

the clustering was the presence of diuretics, followed by the presence of laxatives. The total number of purging episodes and the presence of vomiting achieved lower relevance for the clustering.

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The table included in the right panel of Figure 1 contains the centroids for the indicators in the clustering (prevalence for each purging behaviour and mean for the total purging episodes), which summarises the clusters patterns for this set of variables. Cluster 1 included participants who only reported the presence of vomiting (all the participants in the group reported this behaviour) and registered the lowest mean for the total purging episodes (equal to 7.0). Cluster 2 comprised participants who reported the presence of vomiting (prevalence into the cluster equal to 60%) and laxatives (prevalence equal to 100%) and the mean for the total purging episodes was 14.4. Cluster 3 consisted of participants who reported the presence of vomiting, laxatives and diuretics (with prevalences equal to 57.4%, 61.7% and 100%), and the mean for the total purging episodes was the highest (equivalent to 26.5).

Purging severity distribution according to DSM-5 criteria

Figure 2 includes the 100%-stacked bar chart with the distribution of the purging severity classification based on the DSM-5 (APA, 2013) for BN severity criteria into each empirical cluster identified by the Two-step-cluster. Most patients in Cluster 1 were classified in the DSM-5 mild (42.1%) and moderate (34.7%) severity levels. Cluster 2 included patients pertaining to the DSM-5 moderate (36.4%), severe (20.0%) and the extreme level (41.8%). Finally, the majority of patients in Cluster 3 were classified as extreme by the DMS-5 (76.6%).

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Comparison between the empirical clusters

The first block of Table 1 contains the global comparison between the three empirical clusters for the sociodemographic variables. Statistical differences emerged for the chronological age and the occupational status. Concretely, patients in Cluster 1 were significantly younger than patients in Cluster 3. Regarding employment status, when compared to the other two clusters, Cluster 1 included a higher prevalence of employed women, while Cluster 2 included a higher prevalence of students.

Table 2 contains the comparison between the 3 clusters for the clinical variables of the study. The comparison between Cluster 1 and Cluster 2 only obtained differences for the mean score in the EDI-2 drive for thinness scale (higher mean for patients in Cluster 2) statistically. Significant differences were obtained for the comparisons between Clusters 1 and 3; patients in Cluster 1, reported a shorter duration of the ED, reported lower scores in EDI-2 drive for thinness and perfectionism scales and lower TCI-R persistence scores. Cluster 2 and 3 differed significantly for age of ED onset, with the oldest age of ED onset being reported for the Cluster 3 patients.

Comparison between the empirical clusters with a healthy control group

Table 2 also includes the clinical comparison between the empirical clusters and the HC group. All clusters obtained significantly higher scores from the HCs on all ED symptomatology (EDI-2) and general psychopathological (SCL-90-R) scales, as well as the variables of body composition measuring fat mass, muscle mass and highest ever recorded (maximum) BMI. Furthermore, Cluster 3 presented with a higher current BMI than the HC

group and Cluster 2, and revealed a higher minimum lifetime BMI than the HC group. Regarding the personality profile (TCI-R), Cluster 1 differed statistically from the HC group in all the scales. However, no differences were found when comparing Cluster 2 and Cluster 3 to the HC for novelty seeking, persistence and self-transcendence.

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Discussion

To date, no previous research has employed a taxometric approach to assess whether PD patients can be classified into natural occurring groups. The aim of the current study was, therefore, to use cluster analyses for the first time on a large sample of PD patients, and to assess the clinical significance (comparison to an HC group) of the emerging clusters on a range of ED related factors (e.g. EDI-2), general psychopathology (SCL-90-R) and personality traits (TCI-R). Our study revealed four main findings. First, a 3-cluster profile was the best fitting solution for our PD data. These clusters had the following characteristics; Cluster 1 (only vomiting), Cluster 2 (vomiting and laxative use) and Cluster 3 (vomiting, laxative and diuretic use). Secondly, only a few significant differences in the assessed eating disorder, general psychopathology and personality variables were obtained; these were mainly between Cluster 1 and Cluster 3. Overall, Cluster 1 represented a milder version of PD, whereas Cluster 3 was characterised by a more severe presentation of PD. Thirdly, we found distinctiveness for our three clusters from the HC group, on the ED and general psychopathology variables, but less so for the personality scales. Fourthly, results showed some correspondence of the three clusters with the DSM-5 (APA, 2013) severity index for purging behaviours for BN. The significance of these findings will be discussed further in the subsequent paragraphs.

Cluster analysis of overall PD sample

Our first findings revealed that distinct subgroups of PD patients emerged using the purging behaviours of vomiting, laxative and diuretic misuse as indicators. To date, no empirically derived PD profile model on a representative distribution of PD patients has been reported in the literature. The best-fitting statistical and clinically meaningful solution revealed a 3-cluster profile. Cluster 1 (*n*=121, 54.3%), representing the largest class, was characterised exclusively by vomiting. Conversely, Cluster 2 (*n=55;* 24.6%) and Cluster 3 (n=47, 20.2%) were considerably smaller and presented with multiple purging behaviours. Cluster 2 comprised individuals who vomited and abused laxatives, whereas Cluster 3 entailed all three purging behaviours (vomiting, laxative and diuretic use). In line with our findings, a previous study by Ekeroth and colleagues (2013), also indicated that 82% of their PD group (*n*=184), presented with regular vomiting behaviour. In contrast, diuretic and laxative misuse was only observed in 18% and 7 % of the PD sample, respectively.

Differences across PD clusters and healthy controls

Differences across PD clusters

Interestingly, only a few significant differences emerged across the three clusters, mainly between Cluster 1 and Cluster 3. Patients in Cluster 1 reported a shorter ED illness duration and lower scores on some of the EDI-2 (drive for thinness and perfectionism) and TCI-R (persistence) subscales than women in Cluster 3. Cluster 1 and Cluster 2 only differed on the EDI-2 drive for thinness variable, with Cluster 2 endorsing a higher drive for thinness than Cluster 1. Differences amongst drive for thinness between the clusters are of interest, given

that purging behaviours are currently defined as a means to control weight and shape. Our findings are in line with other studies (e.g. Keel & Striegel-Moore, 2009), which reported that PD patients frequently endorse high levels of drive for thinness, specific dietary rules, and present with an extreme need to control weight and shape. This finding might suggest that future PD research should consider not just weight and shape concerns, but also drive for thinness as a possible motivator for purging behaviours, when defining and characterising PD.

Cluster 3 presented with all three purging methods and had the most considerable mean weekly frequency of overall purging behaviours (mean value of 26.5, compared to 7 and 14.4 for Cluster 1 and 2, respectively). It, therefore, makes sense that Cluster 3 presented with the most severe outcomes in the validation analyses. Previous studies (e.g. Edler, Haedt, & Keel, 2007; Keel et al., 2004) have noted differences across single (Cluster 1), versus multiple (Cluster 2 and Cluster 3) purging methods and indicated that the use of various methods of purging was supportive of incremental validity for envisaging ED severity and general psychopathology. Given that Cluster 3 did not just have the highest number of purging methods, but also the highest mean frequency of purging behaviours, it is also possible that purging frequency, rather than the number of purging methods, is a marker of ED severity. Future studies, therefore, would benefit from further clarifying whether the number of purging methods, the frequency of any single purging behaviour, or a combination of both, provide an indication of ED severity in PD patients.

Differences between PD clusters and healthy controls (clinical significance)

Our third main finding was that the three clusters were found to differ significantly from the HC group in all eating symptomatology and general psychopathological variables as well as

the variable maximum BMI. These findings are in concordance with previous studies (e.g. Brown, Haedt-Matt, & Keel, 2011; Fink, Smith, Gordon, Holm-Denoma, & Joiner, 2009; Keel, Holm-Denoma, & Crosby, 2011; Tasca et al., 2012; Wade, 2007), included in the recent meta-analysis by Smith and colleagues (2017). Our findings corroborate and extend these studies, as we also found higher levels of ED-related and general psychopathology within the three distinct Clusters of PD patients when compared to controls. Accordingly, the taxometric studies in the PD literature that have included a control group (e.g. Keel et al., 2004; Pinheiro et al., 2008), have also all been able to support a distinction between normality and PD for ED symptomatology by indicating no PD samples in their derived relatively healthy groups.

With regards to maximum BMI, our findings are consistent with prospective longitudinal studies, that have shown that a higher BMI in early adolescence was related to a subsequent BN, BED and PD diagnosis (e.g. Allen, Byrne, & Crosby, 2015; Berkowitz et al., 2016; Yilmaz, Gottfredson, Zerwas, Bulik, & Micali, 2019). Conversely, for current BMI, only Cluster 3 presented with a significantly higher BMI than the HC group. A higher BMI of PD patients compared to HCs and other EDs has also been confirmed in other studies [for a review see Keel, 2019). The higher frequency and more varied methods for purging evident in Cluster 3, may suggest that a higher current BMI is associated with using more extreme weight control methods, which may contribute to a more severe clinical presentation.

Concerning personality, the HC group differed statistically from Cluster 1 for all the scales. Still, no differences were found when comparing the HC group with Cluster 2 and Cluster 3 for novelty seeking, persistence and self-transcendence. The non-significant findings for Cluster 2 and Cluster 3 for novelty seeking and persistence are surprising, given

that Cluster 3 presented with the highest weekly vomiting frequency. This contradicts previous studies (e.g. Brown et al., 2011) that have indicated that higher trait impulsivity is associated with more frequent purging behaviours. However, our results support those of Davis, Smith and Keel (2020) who found that the PD patients did not score significantly higher on the impulsigenic traits, lack of premeditation and lack of perseverance when compared to HCs. Interestingly, PD participants did, however, score substantially higher on negative urgency when compared to HCs. Therefore, as the authors conclude, negative urgency may a particularly important feature of impulsivity for PD symptomatology. In the current study, negative urgency was not assessed. Further studies are therefore needed to replicate our and Davis and colleagues' (2020) findings. It is also worth noting that our non-significant findings could have resulted from the fact that our control group was significantly younger than the PD group. Research has shown that impulsivity declines with age (e.g. Steinberg et al., 2008). Further research would, therefore, benefit from including a control group that is matched in age to the clinical group.

Correspondence with the DSM-5 severity index for BN

In terms of the correspondence of our three clusters with the DSM-5 severity specifiers, our fourth finding indicated a considerable amount of overlap between the two classification systems; however, the correspondence between the two was imprecise. Specifically, Cluster 1, which based on previous comparison analyses across the clusters, was deemed the mildest PD form, comprised a total of 23.2% individuals in the severe (8-13 episode) and extreme (≥14 episodes) purging categories. Accordingly, for Cluster 3, which was found to be the most severe cluster, 10.6% of the participants were in the moderate (4-7 episode) category. These findings are in concordance with previous studies, that have shown BN severity specifiers not to be associated with more severe ED symptoms and psychopathology across

the severity groups (e.g. Gianini et al., 2017) or AN (e.g. Machado, Grilo, & Crosby, 2017; Flament et al., 2015). However, some studies have reported modest trends between the severity groups and severity of the clinical presentation for BN (e.g. Grilo et al., 2015; Nakai et al., 2017; Zayas et al., 2018) and AN (e.g. Dakanalis, Alix Timko, Colmegna, Riva, & Clerici, 2018; Gianini et al., 2017). Yes, other studies have provided strong concurrent validity for the DSM-5 severity indices concerning ED symptom severity in BED (e.g. Dakanalis, Colmegna, Riva, & Clerici, 2017). Given these inconsistent findings, further research investigating the utility of the current DSM-5 BN severity index for PD is required. It would, for instance, be of interest to assess whether the distinct symptom domains obtained from the present analyses, such as drive for thinness, perfectionism, persistence and current BMI, in addition to purging frequency may provide a more accurate marker of severity for PD, rather than purging frequency alone.

Limitations and strengths

Even though our findings are compelling, the present study is not without limitations. First, our results are based on cross-sectional data collection. Secondly, our data are mainly based on self-reported questionnaires from routine clinical assessments; however, structured clinical interviews and objective measures were also used. Thirdly, our control group was not matched on demographic variables with the PD group, with the results of includingyounger patients compared with the clinical group. The lack of a paired sampling procedure could add other differences between the subgroups analyzed in the study, such as personality traits. We must outline that this work was carried out with all the women consecutively attended in the treatment unit during the time that the data was recruited, as well as all the controls also recruited during the same period. There are three reasons for the decision of considering the complete control group: a) to increase the statistical power to identify potential differences

between this subsample and the three empirical clusters; b) to increase the external validity of the research (the absence of a matched-paired sampling procedure let suppose that the control sub-sample represents more reliable the original population of women without ED); c) precisely, having a control group that is more representative of the original general population of non-ED women allows to explore the differences and similitudes between each empirical cluster with this control group regarding the sociodemographic profile and other clinical variables (such as the personality traits). The fourth limitation of the study: only objective but not subjective binge eating episodes were applied to define our PD group, which was mainly due to the difficulties in assessing subjective binge eating episodes reliably (e.g. Keel, 2007; Keel & Striegel-Moore, 2009). Importance of loss of control during overeating in PD was also not assessed in the current study. Both subjective binges eating episodes and loss of control while overeating, have previously been found to be associated with purging behaviours (e.g. Forney, Bodell, Haedt-Matt, & Keel, 2016) and would, therefore, require more detailed attention in further taxometric approaches of PD patients. Fifthly, analyses were restricted to women, raising questions about the generalizability of findings to men with PD. Sixthly, we have no data on diagnostic cross-over in our PD sample. It would be interesting to consider this information in further studies. Finally, even though PD patients also engage in other behaviours to compensate for eating, including excessive exercise and extreme fasting, these behaviours were not included in our PD definition, mainly because there is currently less agreement whether these behaviours should be included in the classification of PD (e.g. Pinheiro et al., 2008). Future studies would benefit from providing a more explicit definition regarding these additional compensatory behaviours.

Clinical implications

Our findings have shown that PD is a clinically significant disorder for which patients seek treatment. Clinicians are encouraged to provide a careful assessment of specific features of PD patients based on the three PD clusters identified in the current study. At this time, it is not clear what forms of treatment may be most beneficial for PD patients. Our team has initially shown promising results of a cognitive behaviour therapy (CBT) program in reducing purging behaviours and improving ED related symptomatology in a PD sample (Riesco et al., 2018), although with high dropout rates. Given the few significant differences between the three PD clusters in the current study, it is likely that treatment would benefit all three PD subtypes, however further treatment effectiveness studies, not just using a CBT approach, but also other treatments that are effective in reducing bulimic symptoms, such as interpersonal therapy (e.g. Karam, Fitzsimmons-Craft, Tanofsky-Kraff, & Wilfley, 2019; Linardon, Fairburn, Fitzsimmons-Craft, Wilfley, & Brennan, 2017) and dialectical behaviour therapy (e.g. Ben-Porath et al., 2020) would need to be assessed in a PD population. Clinicians should try to monitor progress throughout treatment and record those interventions that appear to be useful in changing symptoms with a specific focus on the primary symptoms (e.g. BMI, drive for thinness, perfectionism and persistence) that seem to differentiate across the three PD classes.

Conclusions

This study adds to a growing literature on the validity and distinctiveness of PD and provides evidence of dimensional symptom differences within PD. Overall, our findings extend the current literature by providing empirical support for our three ED subtypes as clinically significant EDs in terms of ED symptoms and general psychopathology, but further research needs to be undertaken to see whether this distinction also applies to personality. The lack of congruence between the three derived symptom clusters and DSM-5 severity criteria suggest

future research is required to clarify further the relationships between symptom severity and dimensional differences in PD. Also, we must continue to examine symptom severity as it pertains to prognostic outcomes for PD. The possibility remains that the frequency of purging behaviours is not the defining feature of prognosis or recovery from PD, and as such defining severity by this metric is not informative. Further research is therefore required which utilises taxometric approaches on PD illness course, outcome, or treatment response to better characterise this disorder. Further, our understanding of the defining features of PD is impaired given the gaps in the literature about the: 1.) the minimum frequency of purging behaviours to consider them clinical significant; 2.) the difference between single versus multiple purging methods; 3.) the importance of objective versus subjective binge eating that precedes PD and 4.) the nature of body image problems that might best characterise PD patients. There should be flexibility, but still consistency in the way PD is being defined as our understanding of this condition improves. Without such knowledge, it is premature to include PD in DSM-6. Presently, the mostly like course is to continue including PD in DSM with an explicit mention that it is a provisional diagnosis in need of further study.

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References

Allen, K. L., Byrne, S. M., & Crosby, R. D. (2015). Distinguishing Between Risk Factors for Bulimia Nervosa, Binge Eating Disorder, and Purging Disorder. *J Youth Adolesc, 44*(8), 1580-1591. doi:10.1007/s10964-014-0186-8

APA. (2000). *American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 4th edition (4th ed.).*Washington, DC.

APA. (2013). *American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Pub.

Bacher, J. (2000). A probabilistic clustering model for variables of mixed type. *Quality and Quantity, 34*(3), 223-235.

Ben-Porath, D., Duthu, F., Luo, T., Gonidakis, F., Compte, E. J., & Wisniewski, L. (2020). Dialectical behavioral therapy: an update and review of the existing treatment models adapted for adults with eating disorders. *Eat Disord, 28*(2), 101-121. doi:10.1080/10640266.2020.1723371

Berkowitz, S. A., Witt, A. A., Gillberg, C., Rastam, M., Wentz, E., & Lowe, M. R. (2016). Childhood body mass index in adolescent-onset anorexia nervosa. *Int J Eat Disord, 49*(11), 1002-1009. doi:10.1002/eat.22584

Binford, R. B., & le Grange, D. (2005). Adolescents with bulimia nervosa and eating disorder not otherwise specified-purging only. *Int J Eat Disord, 38*(2), 157-161. doi:10.1002/eat.20167

Brown, T. A., Haedt-Matt, A. A., & Keel, P. K. (2011). Personality pathology in purging disorder and bulimia nervosa. *Int J Eat Disord, 44*(8), 735-740. doi:10.1002/eat.20904

Bulik, C. M., Sullivan, P. F., & Kendler, K. S. (2000). An empirical study of the classification of eating disorders. *Am J Psychiatry, 157*(6), 886-895. doi:10.1176/appi.ajp.157.6.886

Cloninger, C. R. (1999). *The Temperament and Character Inventory–Revised.* . St Louis: MO: Center for Psychobiology of Personality, Washington University.

Dakanalis, A., Alix Timko, C., Colmegna, F., Riva, G., & Clerici, M. (2018). Evaluation of the DSM-5 severity ratings for anorexia nervosa in a clinical sample. *Psychiatry Res, 262*, 124-128. doi:10.1016/j.psychres.2018.02.009

Dakanalis, A., Bartoli, F., Caslini, M., Crocamo, C., Zanetti, M. A., Riva, G., . . . Carra, G. (2017). Validity and clinical utility of the DSM-5 severity specifier for bulimia nervosa: results from a multisite sample of patients who received evidence-based treatment. *Eur Arch Psychiatry Clin Neurosci, 267*(8), 823-829. doi:10.1007/s00406-016-0712-7

Dakanalis, A., Clerici, M., Riva, G., & Carra, G. (2017). Testing the DSM-5 severity indicator for bulimia nervosa in a treatment-seeking sample. *Eat Weight Disord, 22*(1), 161-167. doi:10.1007/s40519-016-0324-2

Dakanalis, A., Colmegna, F., Riva, G., & Clerici, M. (2017). Validity and utility of the DSM-5 severity specifier for binge-eating disorder. *Int J Eat Disord, 50*(8), 917-923. doi:10.1002/eat.22696

Dalle Grave, R., & Calugi, S. (2007). Eating disorder not otherwise specified in an inpatient unit: the impact of altering the DSM-IV criteria for anorexia and bulimia nervosa. *Eur Eat Disord Rev, 15*(5), 340-349. doi:10.1002/erv.805

Davis, H. A., Smith, G. T., & Keel, P. K. (2020). An examination of negative urgency and other impulsigenic traits in purging disorder. *Eat Behav, 36*, 101365. doi:10.1016/j.eatbeh.2020.101365

Derogatis, L. R. (1990). *SCL-90-R. Administration, scoring and procedures manual. Baltimore MD: Clinical Psychometric Research.*Baltimore MD: Clinical Psychometric Research.

Derogatis, L. R. (2002). *SCL-90-R. Cuestionario de 90 síntomas-Manual. Madrid: TEA Editorial.*: Madrid: TEA Editorial.

Edler, C., Haedt, A. A., & Keel, P. K. (2007). The use of multiple purging methods as an indicator of eating disorder severity. *Int J Eat Disord, 40*(6), 515-520. doi:10.1002/eat.20416

Fink, E. L., Smith, A. R., Gordon, K. H., Holm-Denoma, J. M., & Joiner, T. E., Jr. (2009). Psychological correlates of purging disorder as compared with other eating disorders: an exploratory investigation. *Int J Eat Disord, 42*(1), 31-39. doi:10.1002/eat.20556

Finner, H. (1993). On a monotonicity problem in step-down multiple test procedures. *J Am Stat Assoc, 88(423), 920-923.*

First, M., Williams, J., Karg, R., & Spitzer, R. (2015). Structured clinical interview for DSM-5-clinical version (SCID-5 for DSM-5, clinical version; SCID-5-CV, version 1.0. 0). *Arlington: American Psychiatric Association*.

First, M. B., Spitzer, R. L., Gibbon, M. W., & Williams, J. B. (2002). Research version, Non-Patient Edition. *New York: New York State Psychiatric Institute, Biometrics Research*.

Forney, K. J., Bodell, L. P., Haedt-Matt, A. A., & Keel, P. K. (2016). Incremental validity of the episode size criterion in binge-eating definitions: An examination in women with purging syndromes. *Int J Eat Disord, 49*(7), 651-662. doi:10.1002/eat.22508

Garner, D. (1991). *Eating Disorder Inventory-2.* FL Odessa: Psychological Assessment Resources.

Garner, D. (1998). *Inventario de Trastornos de la Conducta Alimentaria (EDI-2)*. Madrid: Masson.

Gianini, L., Roberto, C. A., Attia, E., Walsh, B. T., Thomas, J. J., Eddy, K. T., . . . Sysko, R. (2017). Mild, moderate, meaningful? Examining the psychological and functioning correlates of DSM-5 eating disorder severity specifiers. *Int J Eat Disord, 50*(8), 906-916. doi:10.1002/eat.22728

Grilo, C. M., Ivezaj, V., & White, M. A. (2015). Evaluation of the DSM-5 severity indicator for bulimia nervosa. *Behav Res Ther, 67*, 41-44. doi:10.1016/j.brat.2015.02.002

Gutiérrez-Zotes, J. A., Bayón, C., Montserrat, C., Valero, J., Labad, A., & Cloninger, C. R. . (2004). Temperament and Character Inventory-Revised (TCI-R). Standardization and normative data in a general population sample. *Actas Españolas de Psiquiatria, 32(1)*, 8-15.

Jenkins, P. E., Luck, A., Cardy, J., & Staniford, J. (2016). How useful is the DSM-5 severity indicator in bulimia nervosa? A clinical study including a measure of impairment. *Psychiatry Res, 246*, 366-369. doi:10.1016/j.psychres.2016.10.011

Karam, A. M., Fitzsimmons-Craft, E. E., Tanofsky-Kraff, M., & Wilfley, D. E. (2019). Interpersonal Psychotherapy and the Treatment of Eating Disorders. *Psychiatr Clin North Am, 42*(2), 205-218. doi:10.1016/j.psc.2019.01.003

Keel, P. K. (2007). Purging disorder: subthreshold variant or full-threshold eating disorder? *Int J Eat Disord, 40 Suppl*, S89-94. doi:10.1002/eat.20453

Keel, P. K. (2019). Purging disorder: recent advances and future challenges. *Curr Opin Psychiatry, 32*(6), 518-524. doi:10.1097/YCO.0000000000000541

Keel, P. K., Crosby, R. D., Hildebrandt, T. B., Haedt-Matt, A. A., & Gravener, J. A. (2013). Evaluating new severity dimensions in the DSM-5 for bulimic syndromes using mixture modeling. *Int J Eat Disord, 46*(2), 108-118. doi:10.1002/eat.22050

Keel, P. K., Fichter, M., Quadflieg, N., Bulik, C. M., Baxter, M. G., Thornton, L., . . . Kaye, W. H. (2004). Application of a latent class analysis to empirically define eating

disorder phenotypes. *Arch Gen Psychiatry, 61*(2), 192-200. doi:10.1001/archpsyc.61.2.192

Keel, P. K., Holm-Denoma, J. M., & Crosby, R. D. (2011). Clinical significance and distinctiveness of purging disorder and binge eating disorder. *Int J Eat Disord, 44*(4), 311-316. doi:10.1002/eat.20821

Keel, P. K., & Striegel-Moore, R. H. (2009). The validity and clinical utility of purging disorder. *Int J Eat Disord, 42*(8), 706-719. doi:10.1002/eat.20718

Koch, S., Quadflieg, N., & Fichter, M. (2013). Purging disorder: a comparison to established eating disorders with purging behaviour. *Eur Eat Disord Rev, 21*(4), 265-275. doi:10.1002/erv.2231

Linardon, J., Fairburn, C. G., Fitzsimmons-Craft, E. E., Wilfley, D. E., & Brennan, L. (2017). The empirical status of the third-wave behaviour therapies for the treatment of eating disorders: A systematic review. *Clin Psychol Rev, 58*, 125-140. doi:10.1016/j.cpr.2017.10.005

Machado, P. P., Grilo, C. M., & Crosby, R. D. (2017). Evaluation of the DSM-5 Severity Indicator for Anorexia Nervosa. *Eur Eat Disord Rev, 25*(3), 221-223. doi:10.1002/erv.2508

Mitchell, J. E., Crosby, R. D., Wonderlich, S. A., Hill, L., le Grange, D., Powers, P., & Eddy, K. (2007). Latent profile analysis of a cohort of patients with eating disorders not otherwise specified. *Int J Eat Disord, 40 Suppl*, S95-98. doi:10.1002/eat.20459

Nakai, Y., Nin, K., Noma, S., Teramukai, S., Fujikawa, K., & Wonderlich, S. A. (2017). The impact of DSM-5 on the diagnosis and severity indicator of eating disorders in a treatment-seeking sample. *Int J Eat Disord, 50*(11), 1247-1254. doi:10.1002/eat.22777

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural equation modeling: A multidisciplinary Journal, 14*(4), 535-569.

Pinheiro, A. P., Bulik, C. M., Sullivan, P. F., & Machado, P. P. (2008). An empirical study of the typology of bulimic symptoms in young Portuguese women. *Int J Eat Disord, 41*(3), 251-258. doi:10.1002/eat.20497

Riesco, N., Aguera, Z., Granero, R., Jimenez-Murcia, S., Menchon, J. M., & Fernandez-Aranda, F. (2018). Other Specified Feeding or Eating Disorders (OSFED): Clinical heterogeneity and cognitive-behavioral therapy outcome. *Eur Psychiatry, 54*, 109-116. doi:10.1016/j.eurpsy.2018.08.001

Rousseeuw, P. J. (1987). Silhouettes: a graphical aid to the interpretation and validation of cluster analysis. *Journal of computational and applied mathematics, 20*, 53-65.

Smith, K. E., Crowther, J. H., & Lavender, J. M. (2017). A review of purging disorder through meta-analysis. *J Abnorm Psychol, 126*(5), 565-592. doi:10.1037/abn0000243

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: evidence for a dual systems model. *Dev Psychol, 44*(6), 1764-1778. doi:10.1037/a0012955

Striegel-Moore, R. H., Franko, D. L., Thompson, D., Barton, B., Schreiber, G. B., & Daniels, S. R. (2005). An empirical study of the typology of bulimia nervosa and its spectrum variants. *Psychol Med, 35*(11), 1563-1572. doi:10.1017/S0033291705006057

Sullivan, P. F., Bulik, C. M., & Kendler, K. S. (1998). The epidemiology and classification of bulimia nervosa. *Psychol Med, 28*(3), 599-610. doi:10.1017/s0033291798006576

Swanson, S. A., Horton, N. J., Crosby, R. D., Micali, N., Sonneville, K. R., Eddy, K., & Field, A. E. (2014). A latent class analysis to empirically describe eating disorders

through developmental stages. *Int J Eat Disord*, *47*(7), 762-772. doi:10.1002/eat.22308

Tasca, G. A., Maxwell, H., Bone, M., Trinneer, A., Balfour, L., & Bissada, H. (2012). Purging disorder: psychopathology and treatment outcomes. *Int J Eat Disord*, *45*(1), 36-42. doi:10.1002/eat.20893

Wade, T. D. (2007). A retrospective comparison of purging type disorders: eating disorder not otherwise specified and bulimia nervosa. *Int J Eat Disord*, *40*(1), 1-6. doi:10.1002/eat.20314

Wade, T. D., Crosby, R. D., & Martin, N. G. (2006). Use of latent profile analysis to identify eating disorder phenotypes in an adult Australian twin cohort. *Arch Gen Psychiatry*, *63*(12), 1377-1384. doi:10.1001/archpsyc.63.12.1377

Yilmaz, Z., Gottfredson, N. C., Zerwas, S. C., Bulik, C. M., & Micali, N. (2019). Developmental Premorbid Body Mass Index Trajectories of Adolescents With Eating Disorders in a Longitudinal Population Cohort. *J Am Acad Child Adolesc Psychiatry*, *58*(2), 191-199. doi:10.1016/j.jaac.2018.11.008

Zayas, L. V., Wang, S. B., Coniglio, K., Becker, K., Murray, H. B., Klosterman, E., . . . Thomas, J. J. (2018). Gender differences in eating disorder psychopathology across DSM-5 severity categories of anorexia nervosa and bulimia nervosa. *Int J Eat Disord*, *51*(9), 1098-1102. doi:10.1002/eat.22941

Table 1 Comparison between the empirical clusters with the healthy control group

		Cluster-1		Cluster-2		Cluster-3			Healthy control		Pairwise comparisons (*p*)		
		n=121		*n=55*		*n=47*			*n=822*		C1-HC	C2-HC	C3-HC
		n	*%*	*n*	*%*	*n*	*%*	*p*	*n*	*%*	*p*	*p*	*p*
Origin	*Spain*	107	88.4%	50	90.9%	44	93.6%	.585	811	98.7%	**<.001***	**<.001***	**.008***
	Immigrant	14	11.6%	5	9.1%	3	6.4%		11	1.3%			
Marital	*Single-widow*	100	82.6%	40	72.7%	32	68.1%	.222	744	94.5%	**<.001***	**<.001***	**<.001***
	Married-couple	13	10.7%	11	20.0%	9	19.1%		34	4.1%			
	Divorced-separated	8	6.6%	4	7.3%	6	12.8%		11	1.3%			
Education	*Primary*	59	48.8%	27	49.1%	17	36.2%	.319	10	1.2%	**<.001***	**<.001***	**<.001***
	Secondary	51	42.1%	23	41.8%	21	44.7%		742	90.3%			
	University	11	9.1%	5	9.1%	9	19.1%		70	8.5%			
Occupation	*Unempl.*	53	43.8%	31	56.4%	20	42.6%	**.041***	40	4.9%	**<.001***	**<.001***	**<.001***
	Student	34	28.1%	16	29.1%	21	44.7%		115	14.0%			
	Employed	34	28.1%	8	14.5%	6	12.8%		667	81.1%			
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	*Mean*	*SD*	HC	HC	HC
Age	*Years-old*	25.66	8.69	27.78	10.51	30.94	10.41	**.006***	25.52	5.65	**<.001***	**<.001***	**<.001***

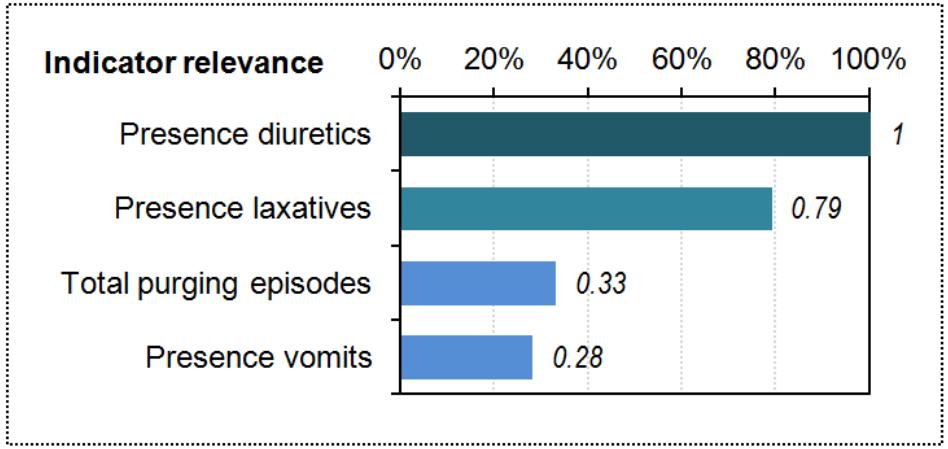
Note. *Bold: significant comparison (.05 level).

Table 2 Clinical comparison between the empirical clusters with the healthy control group

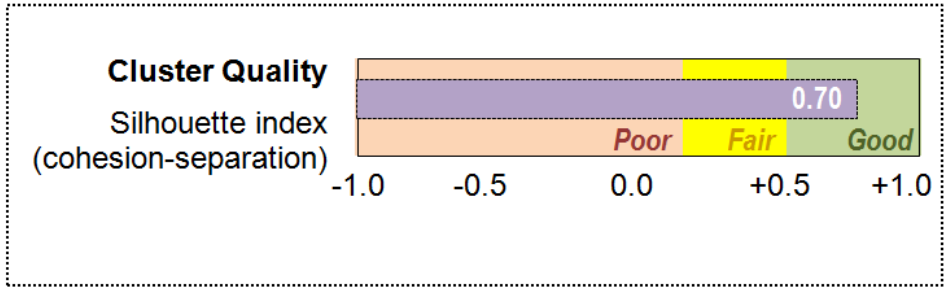
	Means			Pairwise comparisons (*p*)			Mean	Pairwise comparisons (*p*)		
	C1 *n=121*	C2 *n=55*	C3 *n=47*	C1 *vs* C2	C1 *vs* C3	C2 *vs* C3	HC *n=822*	C1 *vs* HC	C2 *vs* HC	C3 *vs* HC
Age of onset (yrs-old)	18.84	19.58	22.94	.546	**.002***	**.025***				
Duration (yrs)	6.89	7.53	6.90	.580	.992	.657				
BMI (current, kg/m^2)	22.30	22.04	23.26	.681	.140	.107	22.29	.988	.564	**.037***
BMI (max., kg/m^2)	27.66	26.48	28.43	.238	.463	.110	23.60	**<.001***	**<.001***	**<.001**
BMI (min., kg/m^2)	20.04	25.38	19.61	.136	.910	.188	20.04	.999	**<.001***	.781
Eating (EDI-2)										
Drive for thinness	14.60	16.25	16.19	**.021***	**.036***	.942	4.18	**<.001***	**<.001***	**<.001***
Body dissatisfaction	17.37	18.27	18.62	.383	.254	.785	6.44	**<.001***	**<.001***	**<.001***
Interoceptive awareness	12.48	12.22	12.91	.776	.653	.534	2.57	**<.001***	**<.001***	**<.001***
Bulimia	5.97	5.65	5.89	.644	.918	.772	1.00	**<.001***	**<.001***	**<.001***
Interpersonal distrust	6.02	6.04	6.87	.975	.209	.288	2.50	**<.001***	**<.001***	**<.001***
Ineffectiveness	11.15	12.20	11.32	.272	.866	.451	2.35	**<.001***	**<.001***	**<.001***
Maturity fears	9.40	9.18	8.13	.795	.147	.296	4.66	**<.001***	**<.001***	**<.001***
Perfectionism	5.69	6.15	7.38	.422	**.005***	.077	3.86	**<.001***	**<.001***	**<.001***
Impulse regulation	7.54	8.25	7.53	.395	.995	.482	1.60	**<.001***	**<.001***	**<.001***
Asceticism	7.66	8.27	7.70	.270	.944	.399	2.38	**<.001***	**<.001***	**<.001***
Social insecurity	7.80	8.18	8.36	.576	.435	.828	2.55	**<.001***	**<.001***	**<.001***
Total score	105.4	110.3	110.7	.352	.344	.954	33.7	**<.001***	**<.001***	**<.001***
Psycho. (SCL-90R)										
Somatization	1.91	2.08	2.00	.157	.485	.578	0.68	**<.001***	**<.001***	**<.001***
Obsessive/comp.	1.93	2.04	2.03	.293	.388	.909	0.86	**<.001***	**<.001***	**<.001***
Interpersonal sensitivity	2.07	2.20	2.20	.284	.304	.992	0.78	**<.001***	**<.001***	**<.001***
Depressive	2.29	2.44	2.36	.192	.520	.607	0.79	**<.001***	**<.001***	**<.001***
Anxiety	1.82	1.92	1.87	.398	.683	.735	0.63	**<.001***	**<.001***	**<.001***
Hostility	1.48	1.63	1.39	.272	.484	.133	0.48	**<.001***	**<.001***	**<.001***
Phobic anxiety	1.06	1.23	1.27	.186	.127	.811	0.20	**<.001***	**<.001***	**<.001***
Paranoid	1.58	1.54	1.54	.718	.695	.965	0.66	**<.001***	**<.001***	**<.001***
Psychotic	1.44	1.45	1.42	.942	.882	.851	0.35	**<.001***	**<.001***	**<.001***
GSI score	1.82	1.94	1.90	.222	.474	.703	0.63	**<.001***	**<.001***	**<.001***
PST score	52.15	50.09	53.81	.654	.733	.508	35.89	**<.001***	**<.001***	**<.001***
PSDI score	2.40	2.48	2.51	.281	.160	.738	1.53	**<.001***	**<.001***	**<.001***
Personality (TCI-R)										
Novelty seeking	102.3	101.6	99.5	.749	.232	.439	99.6	**.017***	.219	.949
Harm avoidance	118.4	119.6	120.4	.665	.479	.796	100.1	**<.001***	**<.001***	**<.001***
Reward dependence	99.9	101.0	98.1	.633	.432	.285	105.7	**<.001***	**.007**	**<.001***
Persistence	109.3	110.4	117.2	.711	**.014***	.069	113.1	**.012***	.219	.079
Self-directedness	114.2	113.3	115.1	.723	.744	.568	142.9	**<.001***	**<.001***	**<.001***
Cooperativeness	132.5	131.2	134.0	.540	.493	.274	138.1	**<.001***	**<.001***	**.016***
Self-Transcendence	66.6	64.6	63.2	.317	.105	.557	63.8	**.028***	.659	.749

Note. HC: healthy control.

Figure 1 *Results of the clustering procedure based on the purging profile*



		CI1	CI2	CI3
Diuretics	No	100%	100%	0%
	Yes	0%	0%	100%
Laxatives	No	100%	0%	38.3%
	Yes	0%	100%	61.7%
Vomits	No	0%	40.0%	42.6%
	Yes	100%	60.0%	57.4%
# purging episodes	Mean	7.04	14.36	26.51



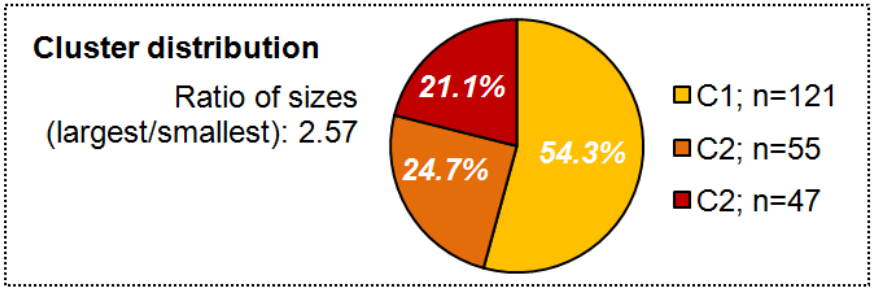


Figure 2 *Distribution of the purging severity based on the DSM-5 into the empirical clustering*