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Distinct profiles of university students engaged in Food and Alcohol Disturbance behaviors

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Abstract

The present study aimed at exploring the combined effect of risk of eating disorders (ED), alcohol use, physical activity, and social and psychological traits in Food and Alcohol Disturbance (FAD) behaviors. Nine-hundred and seventy-six college students were included in the study. They were then divided into two groups based on the Compensatory Eating and Behaviors in Response to Alcohol Consumption Scale (CEBRACS): students with a FAD positive score and student with a FAD negative score. Both groups of participants were compared on the risk of ED, alcohol and physical activity variables, as well as social and psychological dimensions. A cluster analysis was performed on the FAD positive group to determine distinct subgroups and to explore the involvement of social and psychological dimensions in FAD behaviors. The comparison between FAD and non-FAD students demonstrated a more severe alcohol use, risk of ED, a higher level of impulsivity, anxiety, depression and more drinking motives as well as a lower self-esteem in students engaged in FAD behaviors compared with non-engaged students. The cluster analysis identified four clusters: the asceticism FAD subgroup, the damage control FAD subgroup, the emotional FAD subgroup and the recreational FAD subgroup. Overall, results reveal that FAD should not be considered as a unitary behavior but rather as a more complex pattern involving distinct psychological profiles.

Clinical implications

- Food and Alcohol Disturbance (FAD) is associated with distinct drinking motives, facets of impulsivity and psychological traits (low self-esteem, anxiety and depression) in student population.
- Four distinct subgroups of FAD students are identified, suggesting that FAD is a complex behavior.
- Screening and developing care for students and young people with FAD is essential.
- Prevention programs should be adapted to the targeted subgroups of FAD students.

1. Introduction

The co-occurrence of alcohol consumption, eating disorders (ED) and compulsive physical exercise has been frequently reported in college students (Barry & Piazza-Gardner, 2012; Lupi et al., 2017; Piazza-Gardner & Barry, 2012). The term “drunkorexia” was first used in 2008 (Kershaw, 2008) and taken up in several studies (for review see Shepherd et al., 2021) to describe the combination of alcohol consumption, ED and compulsive exercising, as a means to limit weight gain and/or to enhance the psychoactive effects of alcohol. According to Piazza-Gardner & Barry (2013), the term “drunkorexia” is a misnomer because it only refers to food restriction as a means to anticipate alcohol consumption and thus compensate for alcohol-related calories (Choquette, Rancourt, et al., 2018). The term “Food and Alcohol Disturbance” (FAD) is more appropriate to describe a set of ED behaviors occurring before, during or after alcohol use, which aim to compensate for alcohol-related calories intake and/or to maximize the psychoactive effects of alcohol (Choquette, Rancourt, et al., 2018). FAD behaviors refer to of the association at the same time between problematic alcohol use and compensatory behaviors classically observed in ED: These behaviors include caloric restriction, dieting, dysfunctional exercise, and purging through laxative/diuretic use and/or self-induced vomiting (Choquette, Rancourt, et al., 2018). The term FAD refers to the practice of caloric offset to prevent alcohol-related weight gain and/or to enhance the effects of alcohol while intoxicated (for a review, see Shepherd et al., 2021). According to this terminology, some studies reported that up to more than 50% of university students are engaged in FAD behaviors (Choquette, Ordaz, et al., 2018; Knight et al., 2017; Palermo et al., 2021; Peralta et al., 2019), which implies a relatively common behavior.

A first study conducted in college students intended to capture this phenomenon through the development of the Drunkorexia Motives and Behaviors scales (Ward & Galante, 2015). The Drunkorexia motives subscale reflects the social pressure to restrict eating and was related to the coping and conformity subscales of the Drinking Motive Questionnaire (DMQ), suggesting that FAD behaviors serve to decrease negative mood and fit in with others. The Drunkorexia Behaviors subscale reflects strategies to manage caloric intake and was related to the enhancement subscale of the DMQ and heavy episodic drinking. This finding suggests that students with high alcohol consumption engage in FAD behaviors to continue drinking more and enhance the effects of alcohol. A study conducted in adolescents and young adults added that women are more engaged in FAD behaviors for enhancement motives (increase positive affect, make social gatherings funnier) while men are more engaged in FAD behaviors because of difficulties regulating their emotions (in response to negative emotions

and alexithymia; Pompili & Laghi, 2018a). However, in this study, FAD behaviors were assessed based on a single item evaluating eating restrictions prior to alcohol consumption, which represents the main limitation of the findings.

Social norms and social comparison also seem to play an important role in FAD behaviors. Injunctive and descriptive social norms as well as alcohol-specific and ED-related social comparisons were reported as being correlated with FAD engagement in college students (Hill & Ruark, 2021). ED-related social comparison, corresponding to the individual comparisons of one's body, eating and exercise to that of others, and the descriptive norms referring to the perceptions of how people behave, have been found to be the strongest predictors of FAD behaviors, especially for the bulimia dimension (Hill & Ruark, 2021). Thus, students having higher risks of developing ED, engaged in ED-related social comparisons and for whom FAD is considered as a common behavior, are more at risk to engage in FAD behaviors, particularly in bulimia-like behaviors. It is noteworthy that these predictors explained less than 35% of the variance of FAD engagement (Hill & Ruark, 2021), suggesting the involvement of other factors in the complexity of FAD behaviors.

Few studies have explored the role of psychological and affective factors. To our knowledge, three studies conducted in Italian adolescents have examined psychological variables (Laghi et al., 2019, 2021), metacognition processes and positive metacognitive beliefs on alcohol (Laghi et al., 2020). In the first study, FAD behaviors were associated with a low self-esteem, personal alienation implying mainly loneliness, interoceptive deficits reflecting alexithymia, emotional dysregulation with mood instability and impulsivity, and asceticism reflecting self-control, self-discipline and self-restraint (Laghi et al., 2019). The main predictor was emotional dysregulation, suggesting that adolescents engage in FAD behaviors to regulate their emotions and affective states. Asceticism was a secondary predictor of FAD behavior. FAD behavior is characterized by a desire for self-control and high restricted rules in relation to calories intake and alcohol consumption and its relationships with ascetic traits could reflect the use of cognitive and controlled strategies to manage eating behaviors (Laghi et al., 2019). The need to control one's thoughts was also reported as being a significant predictor of FAD behaviors, along with the positive metacognitions about emotional and cognitive self-regulation provided by alcohol use (Laghi et al., 2020). These positive metacognitive beliefs about alcohol may play a critical role in adolescents' motives to engage in FAD behaviors and to regulate their emotions and cognitive processes. Interestingly, an interaction between anxiety and emotion dysregulation in predicting FAD behaviors was found, suggesting that adolescents who present more severe anxiety symptoms are more at risk of developing FAD

behaviors, especially those with high levels of emotional dysregulation (Laghi et al., 2021). However, this interaction explained only 19% of the variance of FAD behaviors (Laghi et al., 2021), encouraging to consider alcohol use and ED (not considered in this study) as well as other psychological and affective variables in the investigation of FAD behaviors. Only two studies have shown that low body esteem and sensation seeking were significant predictors of FAD engagement (Griffin & Vogt, 2020; Hill & Lego, 2019). These studies conclude that FAD is a complex and multifaceted behavior but have not considered psychosocial variables as potential protective or risk factors.

In sum, according to these findings, emotion dysregulation, extreme control, anxiety symptoms and positive metacognitive beliefs about alcohol can be seen as potential risk factors for FAD in adolescents. However, Horvath et al. (2020) failed to evidence a relationship between emotion dysregulation and FAD behaviors in undergraduate students after controlling for alcohol use and ED measures. Overall, there is ample evidence pointing that alcohol use and ED are strongly related to FAD. However, students may have high levels of alcohol consumption and eating disorders, but these behaviors may occur independently rather than concurrently and therefore may not be considered as FAD. Investigating whether students who engage in FAD have higher levels of alcohol consumption and eating disorders than those who do not could provide valuable insights. In addition, further studies are needed to examine more precisely the role of social and psychological characteristics and their interactions in FAD behaviors. Moreover, the part of negative states such as depression, impulsivity and low self-esteem in the engagement of FAD behaviors has not been sufficiently documented. A comprehensive approach including social and psychological traits as well as behaviors associated with FAD (alcohol use, ED, physical activity) is needed to better understand FAD behaviors.

In addition, the aforementioned studies have not considered the possible existence of distinct subgroups of individuals engaged in FAD behaviors, thus limiting the understanding of the implication of these predictors. Indeed, the Compensatory Eating and Behaviors in Response to Alcohol Consumption Scale (CEBRACS; Rahal et al., 2012), which is a useful scale for identifying students engaged in FAD behaviors recently validated in French (Ritz et al., 2023), has been presented as a 4-factors structure, including “enhancement of the effects of alcohol”, “dietary restraint and exercising”, “purging” and “extreme fasting and vomiting”. The separate factors identified on the CEBRACS suggest different behaviors and motives for engaging in FAD. However, the possible existence of FAD subgroups, characterized by distinctive social and psychological traits, has never been established.

Thus, the main goal of the present study was to assess, with a comprehensive approach, the role of internal variables (social and psychological traits) and behaviors associated with the distinct profiles of FAD individuals. The first aim was to establish a comparison between university students engaged in FAD behaviors and those who are not, based on social and psychological characteristics as well as on alcohol use and ED, to provide a comprehensive picture of FAD individuals. These comparisons assess the severity of FAD in relation to their respective motives and associated behaviors. The effect sizes were reported to quantify the magnitude of the difference between the variables. Drawing on previous studies identifying the correlates of FAD behavior, our study examined the levels of impulsivity, depression, anxiety and self-esteem as well as alcohol use, drinking motives, physical activity and ED in a large sample of college students. The hypothesis was that individuals with FAD would experience higher levels of negative states, such as impulsivity, depression, anxiety and low self-esteem, as well as higher levels of motive dimensions to drink and exhibit a higher frequency of alcohol use, physical activity and ED, than non-FAD individuals. These comparisons are intended to examine whether FAD is associated with more severe alcohol use and ED and to determine the motives for FAD and the psychological characteristics of individuals who engage in FAD in order to better understand this behavior and identify those at risk.

The second aim was to explore the existence of distinct profiles among students engaged in FAD behaviors, with a cluster analysis approach including the social and psychological variables. This statistical analysis will allow to test the hypothesis of the differential involvement of social and psychological variables across FAD subgroups and contribute to a better characterization of students engaged in FAD behaviors. The differences between clusters regarding FAD-related behaviors (alcohol use, physical activity, ED) will then be assessed to better examine the risk factors and their relationships with the distinct identified profiles of FAD individuals.

2. Material and Methods

2.1. Participants

This study is in line with the previous study validating the French version of the CEBRACS (Ritz et al., 2023) and is part of a more extensive research program exploring substance consumption among young adults (ADUC; Alcohol and Drugs at the University of Caen, France). The participants were recruited from the University of Caen Normandy (France)

through an online survey (November 2021 and 2022). All of the participants were native French speakers, were aged between 18-35 years, male or female, enrolled as students at Caen University in all fields of study. A total of 3078 complete surveys were returned (participants who did not answer of all the questionnaire have been excluded) and 976 participants were included in the study after having removed alcohol abstainers who did not report alcohol consumption over the last 12 months (67 % of responders). There were no other inclusion/exclusion criteria. The participants were then categorized as FAD individuals or non-FAD individuals according to their CEBRACS total score (see below for the description of this variable and the cut-off score). The characteristics of the participants are described in table 1.

2.2. Ethics

The study was notified and authorized by the “National Commission for Information Technology and Civil Liberties” with the number u24-20171109-01R1. Since students were invited to participate via their formal university e-mail address, the University Information System Direction has developed a security system guaranteeing complete anonymity to the responders. All participants were informed about the study (purpose of the study and data collection) prior to their inclusion and provided their written informed consents, in accordance with the Declaration of Helsinki (Cook et al., 2003). The Ethical Principles of Psychologists and Code of Conduct of the American Psychological Association (American Psychological Association, 2016) for the ethical treatment of human participants were respected for all participants.

2.3. Measures

The online survey was created using the LimeSurvey software and assessed sociodemographic (age and gender) variables. The online survey also included several specific scales and questionnaires aimed at assessing the variables of the present study. In order to minimize spurious answers from the participants, the response of each item was presented with dropdown menus or checkboxes (see description of the measures and their associated modalities of answer on the OSF).

2.3.1. Behaviors associated with Food and Alcohol Disturbance

2.3.1.1. FAD behaviours

Food and alcohol disturbance (FAD) was assessed with the Compensatory Eating and Behaviors in Response to Alcohol Consumption Scale (CEBRACS). The CEBRACS is a 21 items Likert scale recently validated in French (Ritz et al., 2023) and previously in the English (Rahal et al., 2012) and Italian languages (Pinna et al., 2015). The CEBRACS aims at investigating compensatory eating behaviors in relation to alcohol consumption over the past three months, intended to compensate for alcohol-related calories intake and/or to enhance the intoxicative effects of alcohol consumption. Each of the three time periods assesses the same compensatory behaviors with items including eating less than usual, skipping meals or entire days of eating, eating low-fat or low-calorie food, exercising, vomiting, and using diuretics or laxatives. For each item, the participants had to indicate the frequency of the behavior (1 = never; 2 = rarely (approximately 25% on occasions); 3 = sometimes (approximately 50% on occasions); 4 = often (approximately 75% on occasions); 5 = nearly always, for three time periods: before drinking, while under the effects of alcohol (during drinking), and after the effects of alcohol have worn off (after drinking). The CEBRACS is divided into four factors (Ritz et al., 2023): “alcohol effects” ($\alpha=0.94$); “dietary restraint and exercising” ($\alpha=0.88$), “purging” ($\alpha=0.87$) and “extreme fasting and vomiting” ($\alpha=0.66$). The total score ($\alpha=0.89$) ranges from 21 to 105 points. A CEBRACS total score >21 points is considered as reflecting an engagement in FAD behavior (Knight et al., 2017; Moeck & Thomas, 2021; Pietrabissa et al., 2018; Rahal et al., 2012; Ritz et al., 2023). Based on these results, the participants with a CEBRACS total score greater than 21 points (who declare they rarely engage in FAD behavior (approximately 25% by occasions) at least on one item) were classified as FAD individuals, while the participants with a CEBRACS total score of 21 (who declare they never engage in FAD behavior) were classified as non-FAD individuals. This cut-off has proven to be useful in identifying students who engaged in FAD behaviors, in the absence of nosological recognition (Ritz et al., 2023).

2.3.1.2. Alcohol consumption

Alcohol consumption was assessed with the French version of the Alcohol Use Disorders Identification Test (AUDIT; Gache et al., 2005). The AUDIT is a 10-item questionnaire designed to identify individuals at risk of developing alcohol-related problems. All questions are scored from 0 to four and the maximum AUDIT score is 40. The AUDIT has been validated and recommended as an effective alcohol measure in college students (Demartini & Carey, 2012). An AUDIT score ≥ 6 for women and ≥ 7 for men reflects a risk of developing alcohol-related problems (Gache et al., 2005). The students were also interviewed to

determine the age at which they started consuming alcohol (age of onset), their alcohol consumption per week (in standard drinks, a standard drink corresponding to a beverage containing about 10 g of pure alcohol) and the frequency with which they drink in a typical week (ranging from 1 to 7 days, see table 1 for details).

2.3.1.3. Risk of developing eating disorders

The SCOFF questionnaire is designed to screen the risk of developing eating disorders in the at-risk- and student populations (Garcia et al., 2010, 2011). The SCOFF questionnaire is composed of five dichotomous questions (“yes” or “no” answers), with a total score ranging from 0 to 5 (see table 1). The established threshold is set at least two positive answers. The SCOFF sensitivity and specificity were 94.6% and 94.8% respectively for the risk of developing ED in the student population (Garcia et al., 2010). The students were also asked about the frequency with which they use laxative over the past three months (from never “0” to very often “4”), the frequency with which they limited food intake at each meal (dietary restraint) over the past three months (from 0 never to 4 very often) and the frequency with which they exercised to burn calories (from never “0” to very often “4”).

2.3.1.4. Physical activity

The participants were also asked about their physical activity (i.e., “do you exercise?” answer “yes” or “no”, the number of hours per week they exercise and the intensity of the exercise sessions from “very low” =1, “low” = 2, “medium” = 3, “high” = 4 and “very high” = 5; see table 1).

2.3.2. Psychological traits and motives

Drinking motives were assessed by the Drinking Motives Questionnaire-Revised (DMS-R; Grant et al., 2007) in the French short-form (12 items; Kuntsche & Kuntsche, 2009). The participants had to answer the following questions: “In the last 12 months, how often did you drink ...” on a Likert-scale from “never” = 1 to “always” = 5. This scale includes four motive dimensions to drink: social (e.g. “to be sociable”, “as a way to celebrate”; $\alpha=0.83$), coping (e.g. “to relax”, “because I feel more self-confident or sure of myself”; $\alpha=0.87$), enhancement (e.g. “because I like the feeling”, “to get a high”; $\alpha=0.74$) and conformity (e.g. “to be liked”, “because my friends pressure me to use”; $\alpha=0.86$).

Impulsivity was assessed with the short French version (20-items scale) of the UPPS-P Impulsive Behavior Scale (Billieux et al., 2012) measuring five facets of impulsivity: lack of

premeditation (for example: “My thinking is usually careful and purposeful”; $\alpha=0.79$), positive urgency (e.g. “I tend to act without thinking when I am really excited”; $\alpha=0.72$), negative urgency (e.g. “When I feel rejected, I will often say things that I later regret”; $\alpha=0.83$), lack of perseverance (e.g. “I generally like to see things through to the end”; $\alpha=0.88$) and sensation seeking (e.g. “I quite enjoy taking risks”; $\alpha=0.83$). The *Anxiety trait* was measured with the French version of the State-Trait Anxiety Inventory (STAI; 20-item scale; Spielberger, 1983; $\alpha=0.93$), *depression* with the French version of the Beck Depression Inventory (13-item scale; BDI-III; Beck et al., 1961, 1988; $\alpha=0.90$) and *self-esteem* with the French version of the Rosenberg Self-Esteem Scale (EES-10; 10-item scale; Vallieres & Vallerand, 1990; $\alpha=0.92$); (table 1). For these dimensions, the higher the score, the more severe the symptom is.

2.4. Statistical analyses

The normality of the distributions was examined with the Shapiro-Wilk test and both skewness and kurtosis parameters. Group comparisons were examined between participants with FAD positive and FAD negative on all of the variables described in table 1 with parametric (independent Student t-test) or non-parametric tests (Mann Whitney test) according the normality of the distribution. Bonferroni correction was applied to prevent type-I error.

A cluster analysis was conducted on participants with FAD positive behaviors in order to identify sub-groups among this sample. Data grouping was performed with a combination of hierarchical and non-hierarchical methods, as previously achieved (e.g. Lannoy et al., 2017, 2020) and recommended by Hair (2009). The hierarchical analysis was conducted using Ward’s method with a squared Euclidean distance measure. Cluster membership was determined with a non-hierarchical Kmeans analysis. A dendrogram as well as a gap statistic graph were used to determine the number of subgroups and the optimal factor solution. A subgroup should represent more than 10% of the total sample size. The variables included in the cluster analysis were determined according to two principles: variables statistically different between participants with FAD positive and FAD negative and variables representing established risk factors for FAD behaviors in the literature (see Introduction’s section; relevant variables). When selecting variables for cluster analysis, the aim is to retain only the relevant variables and exclude redundant variables (Fop & Murphy, 2018). Relevant variables have a probabilistic dependence on the construct being analyzed (Ritter, 2014) and are independent within the group (i.e., are not highly inter-correlated). Redundant variables

duplicate and contain similar information to that captured by the construct. Behaviors directly associated with FAD, such as alcohol consumption, ED symptoms and physical activity were thus considered as redundant variables, as they directly characterized FAD, and were not included in the cluster analysis. To avoid multicollinearity that could potentially lead to factitious grouping solutions (Hair, 2009) and to maintain relative independence of the internal variables of the cluster analysis (Ritter, 2014), Spearman's correlations were analyzed. Correlation coefficients with an absolute value of $\rho > 0.7$ were considered as being suggestive of multicollinearity (Godefroy et al., 2014). As the scales included in the cluster analysis had different score ranges, all of them were z-score transformed to ensure that each variable had the same metric properties and weight.

The obtained subgroups of participants derived from the cluster analysis were then compared on the basis of the internal variables of the cluster analysis as well as external variables (CEBRACS, alcohol variables, ED variables and physical activity described in table 1). Since the Shapiro-Wilk tests conducted on these 27 variables and the analysis of skewness and kurtosis parameters showed a violation of normality (for 19 variables of them, respectively $p \leq 0.001$ and both skewness and kurtosis values $> |2|$), Kruskal-Wallis analysis of variance followed by post-hoc tests were conducted.

3. Results

3.1. Comparisons between participants with FAD positive and FAD negative behaviors

Thirty-seven % (N=364) of the participants obtained a CEBRACS total score > 21 points and have thus been identified as having FAD behaviors. As reported in table 1, FAD negative and FAD positive students were statistically different in age. Regarding the mean difference (0.45) and the effect size (small), age was not considered as covariate in the subsequent statistical analyses. All following statistical details are presented in Table 1.

On the **CEBRACS** measures, as hypothesized, FAD positive students scored significantly higher in the four factor dimensions than FAD negative students, from small to large effect size. Regarding **alcohol variables**, in the same way, the AUDIT score and the drinking measures including the number of standard drinks per week and the number of days per week of alcohol consumption were significantly higher in FAD positive than in FAD negative students (with small to moderate effect size). Regarding the age of onset, FAD positive students were significantly younger than the negative ones'. On the **DMQ**, FAD positive

students exhibited the highest significant scores in the four dimensions (social, coping, enhancement conformity) compared with FAD negative students, with effect sizes ranging from small to medium. Regarding *risk of ED*, FAD positive students had a significantly higher SCOFF score and reported a significantly higher frequency of dietary restraint and frequency of physical activity than FAD negative ones', with a small effect size. The frequency of laxative/diuretic uses was not statistically different between the two groups. As regards *physical activity*, although the number of hours per week and the intensity of practicing were significantly higher in FAD positive than in FAD negative students, a very small effect size was found. Finally, regarding *psychological traits*, on the UPPS assessing impulsivity, FAD positive students have significantly higher scores in the positive and negative urgency, lack of perseverance and sensation seeking dimensions, compared with FAD negative ones, with a small effect size for all variables. FAD positive students also have a higher level of anxiety (STAI) and depression (BDI) and a lower level of self-esteem (EES) compared with FAD negative students, with a small effect size.

3.2. Cluster analysis on FAD positive participants

The cluster analysis retained and included the following variables as they were statistically different between FAD and non-FAD participants and thus considered as relevant variables for the cluster analysis: the four dimensions of the DMQ (social, coping, enhancement, conformity), the five dimensions of the UPPS (lack of premeditation, both positive and negative urgency, lack of perseverance and sensation seeking), EES, STAI and BDI scores. None of the rho coefficient analyzed within the scales of the DMQ and the subscales of the UPPS reached the absolute value > 0.7 , suggesting the absence of multicollinearity and relative independence.

The cluster analysis performed on FAD positive participants indicates an optimal four-factor solution (see Figure 1). Each of the four clusters exceeded 10% of the sample (Hair, 2009). As reported in table 2 and depicted in figure 2, **Cluster 1** (19% of the sample) was characterized by the lowest values on the social, enhancement and conformity scales of the DMQ and the lowest values on the sensation seeking subscale of the UPPS. Regarding alcohol variables, the participants classified in cluster 1 have the lowest AUDIT score and the lowest score on the CEBRACS factor 1 "enhance the effects of alcohol". The participants in Cluster 1 did not display any differences for the external variables. **Cluster 2** (30% of the sample) was characterized by the highest score on the EES, the lowest score on both the STAI and BDI as well as the lowest values on the negative urgency subscale of the UPPS. The participants

classified in cluster 2 also had the lowest SCOFF score, the highest number of hours of physical activity per week and the highest intensity of practice. They did not differ for the other external variables. *Cluster 3* (16% of the sample) was mainly characterized by the highest values on the coping and conformity scales of the DMQ, on the lack of premeditation and perseverance subscales of the UPPS, by the highest score on STAI and BDI and the lowest score on the EES. Regarding the external variables, the participants from cluster 3 had the highest CEBRACS total score and score in factor 4 (extreme fasting and vomiting). The participants classified in cluster 3 also had the highest number of days of drinking and exercising per week, the highest SCOFF score and the highest frequency of laxative/diuretic uses and of dietary restraint. They did not differ for the other external variables. *Cluster 4* (35% of the sample) was characterized by the highest values on the social and enhancement subscales of the DMQ and sensation seeking subscale of the UPPS. Participants of this cluster did not differ for the external variables.

4. Discussion

The present study 1) aimed at comparing university students engaged in FAD behaviors with those who are not on several social, psychological, alcohol and ED variables and 2) was the first to explore the existence of distinct profiles of FAD students regarding their social and psychological characteristics.

Concerning our first aim, the current findings highlight more severe alcohol use, risk of ED, level of impulsivity, anxiety, depression and drinking motives as well as a lower self-esteem in students engaged in FAD behaviors compared with students who are not. This first finding provides evidence of a clear dissociation between students who engage (regardless of frequency) and those who never engage in FAD (Pompili & Laghi, 2018b).

In our study, the students engaged in FAD behaviors have more alcohol-related disorders, a higher risk of developing ED as well as a higher frequency of dietary restraint and exercising for weight loss and a higher level of physical activity than FAD negatives ones. These results are in line with those obtained in adolescents (Pompili & Laghi, 2018b) and college students (Roosen & Mills, 2015) between restrictors and non-restrictors, with occasional restrictors having unhealthier eating and drinking behaviors than non-restrictors (Pompili & Laghi, 2018b). However, regarding the comparisons on physical activity (frequency and intensity), the effect size in our study is small, suggesting that students engaged in FAD behaviors are not more physically active, contrary to what previous study reported, i.e., that a vigorous physical activity was related to FAD severity (Booker et al., 2020). This may suggest that

college students are likely to exercise less due to their university occupations, contrary to first-year college students (Booker et al., 2020). Similarly, the frequency of laxative/diuretic use is not different between the two groups of students and the comparison of the CEBRACS purging factor shows a relatively small effect size compared to the other CEBRACS factors. This pattern was also reported in the adolescent cohort in which differences were found between heavy restrictors and occasional restrictors in all factors of the CEBRACS, except for laxative use (Pompili & Laghi, 2018b). Moreover, results reveal that FAD positive students start drinking earlier than FAD negative ones. That fits with the idea that these students are more engaged in risky alcohol use. Indeed, students engaged in FAD behaviors report higher levels of drinking motives in the four dimensions of the DMQ in comparisons with FAD negative ones, in agreement with the involvement of coping, conformity and enhancement motives in FAD behaviors (Ward & Galante, 2015). This result must be linked to a higher level of impulsivity, anxiety and depression and a lower level of self-esteem found in students engaged in FAD behaviors. Such psychological difficulties may exacerbate the alcohol- and eating-related disorders observed in FAD students. It is also possible that the specific involvement of these psychological characteristics leads to distinct profiles among these FAD students.

Concerning our second aim, in line with this hypothesis, the results obtained from the cluster analysis identify four FAD subgroups that are diverse in terms of drinking motives, impulsivity and psychological traits, as well as alcohol use, risk of ED and physical activity. According to these findings, the four clusters were deemed as follows: Cluster 1 “asceticism”, Cluster 2 “damage control”, Cluster 3 “emotional FAD” and Cluster 4 “recreational FAD”.

The first subgroup, called “asceticism”, has the lowest enhancement drinking motives and the lowest sensation seeking facets of impulsivity than the other subgroups. These FAD students seem to experience adequate emotional states and are unlikely to engage in risky drinking behaviors. Moreover, students classified within this subgroup have the lowest social motives to drink (referring to making the party better and to the festive aspect of alcohol consumption), the lowest conformity motives, less risk for developing alcohol-related problems and are less engaged in FAD behaviors to enhance the effects of alcohol. They are thus considered as ascetic students. Asceticism is characterized by a tendency to self-discipline and self-denial (Gardner, 2004) when it comes to ED related to self-control and self-restraint (Obeid et al., 2021). Asceticism and the need to control thoughts were found to be predictors of FAD behaviors (Laghi et al., 2019, 2020), reflecting the use of cognitive and controlled strategies to manage eating (Laghi et al., 2019). An ascetic subgroup completely

fits in the context of FAD behaviors characterized by strict self-imposed rules related to the amount of food and alcohol consumed (Laghi et al., 2019). Thus, students characterized by asceticism would engage in FAD behaviors to maintain a healthy lifestyle.

The second subgroup, called “damage control”, is characterized by the highest level of self-esteem as well as by the lowest level of anxiety and depression compared with the other subgroups, which indicates a relatively good mental health. Students classified in this subgroup also have the lowest values on the negative urgency subscale of UPPS. The negative urgency refers to impulsive actions in negative affect contexts and was found to be related to anxious and depressive symptoms (Billieux et al., 2012). Thus, a poor negative urgency of impulsivity suggests that these individuals are likely to better manage their negative feelings and their behaviors in negative emotion situations. This subgroup also has the lowest risk of developing ED on the SCOFF scale but the highest score when it comes to practicing a physical activity (hours per week and intensity of practicing). This finding suggests that students classified in this subgroup are not engaged in FAD behaviors for disordered eating motives but for “damage control” motives. Indeed, in a qualitative study by Dinger et al. (2018) the participants discussed how they used physical activity as a way to offset or counteract the unhealthy effects of binge drinking. This damage control can be seen as a healthy/unhealthy balance in which students compensate for an unhealthy behavior (drinking) by adopting a healthy behavior (physical activity). Interestingly, the participants who reported such intrapersonal motives never mentioned calorie restriction or body weight in their discourse (Dinger et al., 2018). Moreover, physical activity was repeatedly found to be positively associated with alcohol consumption (Barry et al., 2013; Buchholz & Crowther, 2014) and FAD (Booker et al., 2020). Overall, this subgroup therefore seems to engage in FAD behaviors to maintain a positive image of themselves (in relation to high self-esteem) by counteracting alcohol consumption with a healthy physical activity (Dinger et al., 2018).

The third subgroup, called “emotional FAD”, is characterized by elevated coping and conformity drinking motives, suggesting that these students engage in FAD behaviors to reduce negative feelings and to conform with the group (Ward & Galante, 2015). This is confirmed by the higher level of anxiety and depression as well as the lower self-esteem (Griffin & Vogt, 2020; Hill & Lego, 2019) found in this subgroup, suggesting greater psychological difficulties in these students engaged in FAD behaviors (Laghi et al., 2019). To cope with psychological distress, students would drink alcohol more often, which is consistent with the larger number of days of drinking per week reported in this subgroup. To go further, the scores of the AUDIT items were analyzed and showed a greater frequency of AUDIT item

4 “loss of control” (“How often during the last year have you found that you were not able to stop drinking once you had started?”) and 7 “guilt” (“How often during the last year have you had a feeling of guilt or remorse after drinking?”; $p < 0.001$; data available on OSF) within this subgroup compared with the other ones. Thus, in association with a greater lack of premeditation of the impulsivity facet, this may suggest that these students tend to counteract guilty feelings associated with alcohol consumption (Dinger et al., 2018) by engaging in more severe ED and a greater frequency of compensatory behaviors (dietary restraint and exercising to lose weight). The negative feelings experienced by students of this subgroup would come as a consequence of a lack of control over alcohol consumption (drink more often than expected and others) and over the desire to control weight gain. Indeed, alcohol misuse (Martin et al., 2020) and ED (Eisenberg et al., 2011; White et al., 2011) have been shown as associated with mental health-related consequences. Furthermore, this subgroup has greater severity of FAD assessed by the CEBRACS and are more engaged in extreme fasting and self-vomiting behaviors. Overall, these findings suggest that this subgroup of FAD students are at high risk of developing alcohol-related problems and ED and should benefit from particular attention due to their psychological difficulties. In addition, in relation to the greater lack of perseverance found in this subgroup (the ability to remain focused on a task that may be boring and/or difficult; Billieux et al., 2012), these students may also be at risk for academic failure, which would further exacerbate their negative states.

Finally, the fourth subgroup, deemed “recreational FAD”, is mainly characterized by social motives to drink, such as the festive aspects of alcohol consumption, as well as enhancement motives and sensation seeking. Sensation seeking is considered as “a tendency to enjoy and pursue activities that are stimulating or exciting and openness to trying new and unconventional experiences” (Billieux et al., 2012) and have been shown to be associated with alcohol use (Donohew et al., 1999; Miller et al., 2003). Surprisingly, students classified in this subgroup do not present high alcohol use nor alcohol-related problems compared with those of the “emotional FAD” subgroup. However, when comparing the AUDIT scores, it appears that the students in this subgroup report a higher frequency in item 3 “How often do you have six or more drinks on one occasion?” compared with the others (< 0.001), suggesting a tendency to binge drink to enhance the psychoactive effects of alcohol. Finally, although the “emotional” and “recreational” subgroups are comparable on the AUDIT total score and CEBRACS Factor 1 “enhancement the alcohol effect”, it seems that they do not drink for the same motives and behavioral manifestations.

Limitations

Our study includes several limitations, notably the unbalanced sex ratio, women being over-represented (71% of the sample). This is the case for most studies conducted in FAD (Choquette, Ordaz, et al., 2018; Palermo et al., 2021; Peralta et al., 2019; Pompili & Laghi, 2018a). Therefore, future studies should include more men to give us a more representative sample to work with. However, there was no significant differences between men and women on the FAD measures in our study. All the variables were assessed using self-reported measures, which is a possible factor to self-report bias (i.e., social desirability). However, since students were contacted by email and completed an online survey, we expected a relatively low desirability bias. The quotation (value) of each item was never made available to the participant when answering in order not to influence the responses and to avoid social desirability bias.

Conclusion

In conclusion, the present study includes several measures of both behaviors associated with FAD and psychological traits and motives, and highlights greater drinking motives in students engaged in FAD behaviors compared with those who are not, suggesting that one of the primary motive in FAD is guided by alcohol consumption. These students also have an elevated score in all impulsivity facets and a higher prevalence of psychological difficulties, i.e. low self-esteem, anxiety and depression symptoms. Our study is the first one to underline different subtypes of FAD students, characterized by distinct drinking motives, facets of impulsivity and psychological traits, as well as separated risk of developing alcohol-related problems and ED. These results have important clinical implications, and shed light on the necessity to screen and develop the care of FAD in student and young people. They particularly suggest that prevention programs should be adapted to the targeted subgroups of FAD students, by focusing on adapted emotional regulation strategies, resumption of control for alcohol consumption or life-skills-based prevention programs. It would be interesting for future studies to examine the reliability of these findings in non-university students (Griffin & Vogt, 2020; Moeck & Thomas, 2021) and clinical samples of individuals with alcohol use and/or ED. Additionally, longitudinal studies would allow to examine the evolution of these distinct profiles of students engaged in FAD behaviors.

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6. Data availability

Data and measures are available: <https://osf.io/rgbtf/>

7. Author contributions

All authors have approved the final manuscript.

L. Ritz: data analyses, writing; N. Mauny: study design, methodology, review and editing; J. Mange: statistical analyses, data interpretation; P. Leconte and N. Margas: supervision, data interpretation, writing (review and editing).

8. Disclosure statement

The authors declare no conflict of interest.

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10. Tables

Table 1: Sample characteristics of the participants

Variables	Non-FAD individuals (CEBRACS = 21 pts) N=612	FAD individuals (CEBRACS > 21pts) N= 364	Statistics p value; effect size
Age <i>Range</i>	20.7 ± 3.10 18-36	20.3 ± 2.80 18-35	0.02*; 0.15 ¹
Gender (Men/Women)	210/402	104/260	0.06 ^a
FAD			
CEBRACS total score <i>Range</i>	21.00 ± 0.00 21-21	28.27 ± 9.05 22-77	<0.001**; 1 ²
CEBRACS “enhance the alcohol effects” factor <i>Range</i>	7.00 ± 0.00 7-7	10.34 ± 5.05 7-35	0.001**; 0.58 ²
CEBRACS “dietary restraint and exercising” factor <i>Range</i>	7.00 ± 0.00 7-7	10.42 ± 5.01 7-35	0.001**; 0.71 ²
CEBRACS “purging” factor <i>Range</i>	5.00 ± 0.00 5-5	5.16 ± 1.08 5-19	0.001**; 0.04 ²
CEBRACS “extreme fasting and vomiting” factor <i>Range</i>	2.00 ± 0.00 2-2	2.35 ± 1.11 2-10	0.001**; 0.15 ²
Alcohol variables			
AUDIT <i>Range</i>	5.83 ± 4.37 0-28	8.86 ± 5.97 0-34	0.001**; 0.35 ²
Age of onset <i>Range</i>	15.82 ± 1.91 7-19	15.47 ± 1.83 7-28	0.005*; 0.19 ¹
Number of standard drinks per week <i>Range</i>	3.48 ± 4.83 0-60	5.73 ± 9.38 0-70	0.001**; 0.21 ²
Number of day per week of alcohol consumption <i>Range</i>	1.62 ± 0.96 1-7	1.89 ± 1.18 1-7	0.001**; 0.14 ²
Drinking Motive Questionnaire			
DMQ-R – Social <i>Range</i>	8.09 ± 3.29 3-15	9.73 ± 3.00 3-15	0.001**; 0.29 ²
DMQ-R – Coping <i>Range</i>	5.06 ± 2.76 3-15	6.58 ± 3.40 3-15	0.001**; 0.27 ²
DMQ-R – Enhancement <i>Range</i>	8.23 ± 3.18 3-15	9.68 ± 2.99 3-15	0.001**; 0.26 ²
DMQ-R – Conformity <i>Range</i>	4.37 ± 2.21 3-15	4.97 ± 2.58 3-15	0.01*; 0.16 ²
Eating disorders variables			
SCOFF <i>Range</i>	0.66 ± 0.94 0-4	1.24 ± 1.24 0-5	0.001**; 0.27 ²
Frequency of laxatives/diuretic uses <i>Range</i>	0.01 ± 0.16 0-2	0.06 ± 0.34 0-4	0.06 ^t

Frequency of dietary restraint <i>Range</i>	0.39 ± 0.96 0-4	1.04 ± 1.45 0-4	0.001**; 0.22 ²
Frequency of exercising <i>Range</i>	0.22 ± 0.76 0-4	0.56 ± 1.19 0-4	0.001**; 0.12 ²
<i>Physical activity</i>			
Number of hours per week <i>Range</i>	1.52 ± 2.23 0-13	1.96 ± 3.04 0-35	0.01*; 0.09 ²
Intensity of practicing <i>Range</i>	1.63 ± 1.83 0-5	1.96 ± 1.87 0-5	0.008*; 0.09 ²
<i>Psychological traits</i>			
UPPS-P – Lack of premeditation <i>Range</i>	7.51 ± 2.32 4-16	7.81 ± 2.28 4-16	0.05*; 0.13 ¹
UPPS-P – Positive Urgency <i>Range</i>	10.20 ± 2.45 4-16	10.57 ± 2.31 4-16	0.02*; 0.18 ¹
UPPS-P – Negative Urgency <i>Range</i>	8.59 ± 2.74 4-16	8.98 ± 2.85 4-16	0.04*; 0.14 ¹
UPPS-P – Lack of perseverance <i>Range</i>	7.98 ± 2.51 4-16	8.47 ± 2.53 4-16	0.003*; 0.18 ¹
UPPS-P – Sensation seeking <i>Range</i>	9.92 ± 2.91 4-16	10.43 ± 2.81 4-16	0.008*; 0.17 ¹
STAI T <i>Range</i>	48.96 ± 12.43 20-78	51.94 ± 12.26 20-79	0.001**; 0.24 ¹
BDI <i>Range</i>	7.40 ± 6.84 0-35	9.71 ± 7.5 0-37	0.001**; 0.32 ²
EES <i>Range</i>	29.04 ± 6.84 10-40	27.50 ± 7.03 10-40	0.001**; 0.22 ¹

Data are shown as mean ± standard deviation

* significant at $p \leq 0.05$; ** significant at $p \leq 0.002$ after Bonferroni correction (29 comparisons)

^a Chi square test

¹ d's Cohen computed from Student's independent t-test; 0.20: small effect size; 0.50: moderate; 0.80: large

² rank biserial correlation computed from Mann-Whitney test; 0.10: small effect size; 0.30: moderate; 0.50: large
t tendency to significance ($0.10 \leq p \leq 0.05$)

FAD: Food and Alcohol Disturbance; CEBRACS: Compensatory Eating and Behaviors in Response to Alcohol Consumption Scale; AUDIT: Alcohol Use Disorders Identification Test; DMQ-R: Drinking Motive Questionnaire-Revised; UPPS-P: Impulsive Behavior Scale; STAI- T: State-Trait Anxiety Inventory Trait; BDI: Beck Depression Inventory; EES: Rosenberg Self-Esteem Scale

Table 2: Descriptive and comparison statistics between clusters among FAD positive students

Variables	Cluster 1 (N=68; 19%)	Cluster 2 (N=108; 30%)	Cluster 3 (N=60; 16%)	Cluster 4 (N=128; 35%)	Statistics* η^2 Post-hoc comparisons
Internal variables²					
DMQ-R – Social	-1.37 ± 0.69	0.10 ± 0.77	0.21 ± 0.88	0.54 ± 0.66	0.001**; $\eta^2=0.39$ C1<(C2=C3)<C4
DMQ-R – Coping	-0.59 ± 0.64	-0.47 ± 0.66	1.28 ± 0.84	0.12 ± 0.88	0.001**; $\eta^2=0.36$ (C1=C2)<C4>C3
DMQ-R – Enhancement	-1.30 ± 0.71	0.14 ± 0.81	0.18 ± 0.92	0.49 ± 0.68	0.001**; $\eta^2=0.36$ C1<(C2=C3)<C4
DMQ-R – Conformity	-0.56 ± 0.43	-0.16 ± 0.78	0.83 ± 1.47	0.04 ± 0.84	0.001**; $\eta^2=0.15$ C1<(C2=C4)<C3
UPPS-P – Lack of premeditation	-0.22 ± 0.94	-0.37 ± 0.90	0.60 ± 1.08	0.14 ± 0.93	0.001**; $\eta^2=0.10$ (C1=C2)<C4<C3
UPPS-P – Positive Urgency	-0.34 ± 0.88	-0.49 ± 0.92	0.45 ± 1.14	0.38 ± 0.78	0.011**; $\eta^2=0.19$ (C1=C2)<(C3=C4)
UPPS-P – Negative Urgency	-0.09 ± 0.88	-0.78 ± 0.68	0.55 ± 1.02	0.45 ± 0.83	0.001*; $\eta^2=0.32$ C2<C1<(C3=C4)
UPPS-P – Lack of perseverance	-0.31 ± 0.96	-0.55 ± 0.71	0.76 ± 0.99	0.27 ± 0.92	0.001**; $\eta^2=0.22$ (C1=C2)<C4<C3
UPPS-P – Sensation seeking	-0.68 ± 0.85	-0.07 ± 0.95	0.27 ± 0.87	0.31 ± 1.11	0.001**; $\eta^2=0.14$ C1<C2<C3<C4
STAI T	0.00 ± 0.75	-1.00 ± 0.67	1.30 ± 0.55	0.23 ± 0.59	0.001** ; $\eta^2=0.59$ C2<(C1=C4)<C3
BDI	-0.13 ± 0.74	-0.83 ± 0.36	1.60 ± 0.78	0.02 ± 0.59	0.001** ; $\eta^2=0.59$ C2<(C1=C4)<C3
EES	-0.15 ± 0.76	0.95 ± 0.62	-1.31 ± 0.64	-0.11 ± 0.66	0.001** ; $\eta^2=0.54$ C2<(C1=C4)<C3
External variables					
CEBRACS total score	24.96 ± 5.26	27.24 ± 6.78	34.22 ± 14.34	28.12 ± 7.86	0.001**; $\eta^2=0.08$ (C1=C2)<C4<C3
CEBRACS “enhance the alcohol effects” factor	7.75 ± 1.59	9.35 ± 3.74	13.28 ± 7.09	11.16 ± 5.21	0.001**; $\eta^2=0.14$ C1<C2<(C3=C4)
CEBRACS “dietary restraint and exercising”	5.19 ± 1.24	5.07 ± 0.59	5.43 ± 1.94	5.08 ± 0.65	ns; p=0.055

factor					
CEBRACS “purging” factor	5.19 ± 1.24	5.07 ± 0.59	5.43 ± 1.94	5.08 ± 0.65	ns
CEBRACS “extreme fasting and vomiting” factor	2.09 ± 0.41	2.19 ± 0.57	3.13 ± 2.13	2.27 ± 0.80	0.001**; $\eta^2=0.07$ (C1=C2=C4)<C3
AUDIT	4.82 ± 3.36	8.18 ± 5.34	11.22 ± 7.05	10.47 ± 5.86	0.001**; $\eta^2=0.20$ C1<C2<(C3=C4)
Age of onset	15.71 ± 1.85	15.76 ± 1.62	15.15 ± 2.11	15.25 ± 1.80	ns
Number of standard drinks per week	3.45 ± 8.74	6.00 ± 8.46	6.96 ± 9.53	6.14 ± 10.21	0.001**; $\eta^2=0.07$ (C1=C2=C4)<C3
Number of days per week of alcohol consumption	1.54 ± 0.95	1.85 ± 1.04	2.49 ± 1.65	1.83 ± 1.04	0.001**; $\eta^2=0.05$ (C2=C3=C4)<C1
SCOFF	1.13 ± 1.15	0.72 ± 1.07	2.23 ± 1.25	1.26 ± 1.12	0.001**; $\eta^2=0.17$ C2(<C1=C4)<C3
Frequency of laxatives/diuretic use	0.00 ± 0.01	0.00 ± 0.01	0.25 ± 0.75	0.02 ± 1.20	0.001**; $\eta^2=0.07$ (C1=C2=C4)<C3
Frequency of dietary restraint	0.98 ± 1.37	0.81 ± 1.35	1.87 ± 1.63	0.87 ± 1.36	0.001**; $\eta^2=0.06$ (C1=C2=C4)<C3
Frequency of exercising	0.51 ± 1.13	0.53 ± 1.22	0.83 ± 1.37	0.49 ± 1.09	ns
Number of hours per week	1.68 ± 2.17	2.60 ± 2.83	1.37 ± 2.51	1.85 ± 3.71	0.001**; $\eta^2=0.05$ (C1=C3=C4)<C2
Intensity of practicing	1.79 ± 1.82	2.49 ± 1.79	1.47 ± 1.83	1.84 ± 1.91	0.004*; $\eta^2=0.04$ (C1=C3=C4)<C2

Data are shown as mean ± standard deviation

* p value was considered as significant at $p \leq 0.05$; ** significant after Bonferroni correction ($p \leq 0.002$ for 27 comparisons); ns: not significant

¹ η^2 computed from Kruskal-Wallis analysis of variance; 0.01: small effect size; 0.06: moderate; 0.14: large

² data are shown as z-score

The shaded boxes in the table represent the lowest or the highest values of the cluster

11. Figures

Figure 1: Gap statistic graph resulting from the cluster analysis

Figure 2: Subgroups of FAD students determined by cluster analysis

DMQ: Drinking Motives Questionnaire; Lack of prem: lack of premeditation; Pos Urgency: Positive Urgency; Neg Urgency: Negative Urgency; Lack of pers: Lack of perseverance; EES: Rosenberg Self-Esteem Scale; STAI: State-Trait Anxiety Inventory; BDI: Beck Depression Inventory
Scale is represented in z-score; dotted lines: mean; solid lines: clusters