



Exploring risk factors of food and alcohol disturbance (FAD) in U.S. college students

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Abstract

Purpose Current research examining mental health and history of childhood trauma as risk factors of food and alcohol disturbance (FAD) is limited. College students may be at greater risk to engage in FAD behaviors because of the common co-occurrence of alcohol misuse and disordered eating behaviors within college populations. Therefore, the current study examined anxiety, depression, and adverse childhood experiences as possible risk factors of FAD behaviors in a college student sample.

Methods Two-hundred and seven undergraduate students from a large Midwest university completed a cross-sectional survey assessing history of adverse childhood experiences, depressive symptoms, anxiety symptoms, FAD behaviors, and frequency of alcohol use.

Results Current symptoms of generalized anxiety were significantly associated with engagement in FAD behaviors (Alcohol Effects subscale, $\beta=0.13$, $F(1, 204)=4.10$, $p=0.04$; Bulimia subscale, $\beta=0.17$, $F(1, 204)=6.19$, $p=0.01$; Diet and Exercise subscale, $\beta=0.19$, $F(1, 204)=9.05$, $p<0.01$). Adverse childhood experiences were associated with engagement in FAD behaviors (Alcohol Effects subscale, $\beta=0.14$, $F(1, 204)=4.27$, $p=0.04$). Current depressive symptoms were not significantly associated with FAD behaviors.

Conclusions Study findings suggest that students who experience greater current symptoms of anxiety are at a greater risk to engage in FAD behaviors. Further understanding the role of anxiety in the development and maintenance of FAD behaviors may provide clinically useful information for the prevention and treatment of FAD behaviors. These findings highlight the need for further research to examine psychological distress as a risk factor for engagement in FAD behaviors longitudinally, in a larger, more diverse study sample.

Level of evidence Level V, cross-sectional descriptive study.

Keywords Food and alcohol disturbance · Adverse childhood experiences · Anxiety · Depression · Alcohol use · College students

Introduction

Disordered eating and alcohol use are commonly co-occurring behaviors among college students [1]. However, a more novel pattern of behaviors, known as food and alcohol disturbance (FAD) has been recognized as problematic drinking behaviors (i.e., alcohol misuse) in co-occurrence with disordered eating as a way for individuals to compensate for

calories gained from alcohol consumption [2, 3]. Individuals engaging in FAD behaviors compensate for the calories consumed through alcohol by restriction of caloric intake prior, during, or after alcohol consumption or engaging in other weight-related compensatory behaviors (e.g., purging, over-exercising) [2, 4–6]. Individuals who engage in this unhealthy pattern of behaviors may be also motivated to increase the effects of intoxication through the engagement in disordered eating [2]. Disordered eating (e.g., skipping meals, caloric restriction) prior to consumption of alcohol can increase the effects of intoxication [7]. Prior literature examining FAD behaviors has shown that some individuals have engaged in disordered eating patterns prior to consuming alcohol to increase the effects of alcohol [1, 2, 4–6].

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Individuals may also be motivated to engage in FAD behaviors due to concerns regarding body image and the drive for thinness [8, 9]. Choquette and colleagues (2018) examined the link between FAD behaviors and the drive for thinness and reported that young adults across France and the U.S. who endorsed drive for thinness were more likely to engage in FAD behaviors for compensatory purposes [9]. While prior research has established the comorbidity of alcohol use and disordered eating behaviors [1], FAD represents a unique construct and disorder given the unique motivations (e.g., to increase intoxication, drive for thinness) driving the engagement of these problematic behaviors [2].

College students may be at high-risk for engagement in FAD behaviors because of their increased engagement in maladaptive and risky behaviors (e.g., illicit drug use, disordered eating, alcohol consumption) [10–12]. Excessive alcohol consumption throughout college has grown to be a perceived norm with social and peer influences [13]. Rates of binge drinking are also high within the U.S. college student population, with rates ranging between 30 and 40% [14]. During the transition to college, students may experience changes in eating behaviors and high stress from the fear of gaining weight often because of a common 15-pound weight gain that occurs during the first year of college [15, 16].

High rates of FAD have been found among college students [17, 18]. Approximately 40% of college students have been found to restrict food and caloric intake prior to alcohol consumption [19]. Among college freshmen specifically, 14% of students have been found to engage in restricting caloric intake before drinking alcohol [6]. College students may be a particularly at-risk group for engagement in FAD behaviors because college is a significant life transition and social norms are commonly a predictor of maladaptive behaviors [20, 21]. With this significant life transition from adolescence into adulthood, there is also an increase in risk-taking among first-year college students [21]. Additionally, engagement in FAD behaviors is concerning because restricting food and caloric intake and participating in alcohol misuse can increase the risk of negative alcohol-related consequences (e.g., blacking out, becoming injured, unwanted, or unprotected sex, alcohol poisoning, and physical fighting) [19, 22]. These co-occurring behaviors can increase the risk of brain and organ damage, nutritional deficits, hypoglycemia, and have negative effects cognitively that could affect future learning [6]. Therefore, it is important to keep in mind the transition to college, maladaptive behaviors, and the potential negative alcohol-related consequences that may put college students at greater risk to engage in FAD behaviors.

While research examining the risk factors of FAD is sparse, adverse childhood experiences have been established as a risk factor for both disordered eating and alcohol use disorders [23, 24]. A systematic review

regarding health outcomes and adverse childhood experiences indicated that individuals who have experienced adverse events in childhood are at an increased risk for heavy alcohol consumption or alcohol-related problems [25]. Similarly, Rothman and colleagues (2008) found that experiencing specific adverse events in childhood (e.g., physical and sexual abuse, household member with mental illness, parental separation/divorce, substance abuse in the home) may increase the risk of early alcohol consumption [26]. During entry to college, first-year college students who have experienced adverse events in childhood are at greater risk for engaging in disordered eating behaviors [27]. Although there is considerable research suggesting adverse childhood experiences as a vulnerability in the development of alcohol misuse and disordered eating behaviors, research has yet to explore adverse childhood experiences as a possible risk factor for FAD.

The association between mental health (e.g., depression, anxiety) and both disordered eating behaviors and alcohol use disorders has been thoroughly established [28–33]. Both depression and social anxiety are recognized as risk factors for alcohol use disorders and alcohol use among college students [32, 34–36]. Disordered eating behaviors co-occur with both anxiety and depression [30, 33]. Further, psychological distress (i.e., depression, anxiety) have been identified as correlates of FAD behaviors specifically within an adolescent sample [37]. Laghi et al. [37] highlighted that emotion dysregulation moderated the relationship between anxiety symptoms and FAD behaviors, such that adolescents endorsing greater symptoms of anxiety and higher levels of emotion dysregulation were at greater risk to engage in FAD behaviors. Given that these findings are representative of an adolescent sample in Italy, it is important to note the possible cross-cultural differences in alcohol consumption norms and legal drinking age across the U.S. and Italy. Since research has established the co-occurrence of disordered eating behaviors, alcohol use, and mental health, it is important to further identify depression and anxiety as possible risk factors of engaging in FAD behaviors in the high-risk population of U.S. college students.

Individuals who engage in binge drinking and frequent alcohol use may be more at risk to engage in FAD behaviors due to the co-occurrence of binge drinking and disordered eating behaviors among college student populations [1, 38]. Further, prior literature has established a link between alcohol consumption with anxiety, depression and experiencing adverse events in childhood [23, 30–32]. Therefore, it is important that we account for frequency of alcohol use when examining the association between psychological distress, adverse childhood experiences and engagement in FAD behaviors as it may provide insight into whether psychological distress and adverse child experiences are uniquely associated with engagement in FAD behaviors. This may provide clinically useful information

moving forward when approaching how to identify and treat FAD behaviors within college student populations since alcohol use is common within these populations [14].

Current study

The aim of the current study is to examine anxiety, depression, and adverse childhood experiences as potential risk factors of engagement in FAD behaviors. Prior research has well established the associations between adverse childhood experiences, depression, and anxiety with disordered eating, alcohol misuse, and compensatory behaviors as separate and individual constructs. However, research has yet to examine adverse childhood experiences, depression, and anxiety as potential risk factors of the unique construct of FAD behaviors within a college student population. Examining risk factors of FAD behaviors among the high-risk population of college students is important given the adverse effects that engaging in these behaviors can pose on an individual's physical and psychosocial health [6, 19, 22]. Therefore, the current study is the first to examine adverse childhood experiences, depression, and anxiety in a college sample as possible risk factors of FAD in a U.S. college student sample. Specifically, it was hypothesized that (1) greater number of adverse childhood experiences, (2) greater current symptoms of anxiety, and (3) greater current symptoms of depression would be predictors of engaging in FAD behaviors while controlling for current alcohol use in a college student sample.

Methods

Participants

Participants were 207 undergraduate students enrolled in an Introduction to Psychology course and recruited through an online research participation system at a large Midwest United States university. Participants were eligible to participate in the study if they were between the ages of 18–25 years. Participants were excluded from the study if they indicated that they were pregnant at the time of the study, due to the influence of pregnancy on drinking behavior. Students in Introduction to Psychology courses are required to either participate in research studies or write a research paper as part of class requirements.

Measures

Demographics and alcohol use

Participants completed a questionnaire created for the current study to assess demographic information (e.g., date of

birth, gender identity, racial background, ethnicity, marital status, employment status, occupation, living arrangements, and family composition). Additionally, the demographic measure assessed for participant's frequency of alcohol use during college. Participants rated their alcohol use frequency on a scale as occurring 'never', 'less than 1–2 times a year', 'once every few months', 'once a month', or 'weekly'. If participants selected 'weekly', they were asked to indicate how many days per week on average they consume alcohol drinks, with response options listed from '1 day' up to '7 days'.

Adverse childhood experiences

Participants completed the self-report *Adverse Childhood Experiences Survey* [39, 40] to assess adverse or traumatic events that occurred throughout childhood. The *ACES* is a well established and validated questionnaire that assesses possible household dysfunction (e.g., violence toward mother, substance abuse, household member imprisoned, mental illness, and parental separation or divorce), abuse (e.g., sexual, physical, emotional, and psychological), and neglect throughout the first eighteen years of life [39, 41]. Participants responded "yes" or "no" to a total of ten questions, with each question asking whether they had experienced a specific adverse event in childhood. The number of events endorsed as "yes" was summed to create a total score. Prior research has demonstrated good reliability of the *ACES* (Cronbach's $\alpha = 0.88$) [41].

Generalized anxiety

Participant's symptoms of anxiety were measured using the self-report *Generalized Anxiety Disorder (GAD-7)* questionnaire [42]. The *GAD-7* consists of seven questions on which participants rate the occurrence of symptoms of anxiety (i.e., nervousness, anxiousness, feeling on edge, worrying too much) from the past two weeks [42, 43]. Participants rate symptoms on a 0–3 scale as occurring 'not at all sure' (0), 'several days' (1), 'over half the days' (2), or 'nearly every day' (3) [42]. Items are summed to provide a total score. Scores of ≤ 5 are recognized as mild symptoms of anxiety, scores of 10–14 are recognized as moderate, and scores of ≥ 15 are recognized as severe symptoms of anxiety [42, 44]. Prior research has demonstrated good internal consistency (Cronbach's $\alpha = 0.92$) and test–retest reliability (intraclass correlation = 0.83) for the *GAD-7*, as well as criterion and construct validity [42, 44].

Depression

Symptoms of depression were assessed through the self-report *Center for Epidemiological Studies Depression*

(*CES-D*) scale [45]. This screener is composed of 20 questions that assess the severity of symptoms of depression during the past week. Participants endorsed symptoms as occurring ‘rarely or none of the time (less than 1 day)’, ‘some or a little of the time (1–2 days)’, ‘occasionally or a moderate amount of time (3–4 days)’, or ‘most or all of the time (5–7 days)’. Scoring of positive items were reversed. Items were summed to provide a total score ranging from 0 to 60 with scores of 0–15 indicating ‘minimal’, scores of 16–23 indicating ‘mild’, and scores of 24 or greater indicating ‘moderate to severe’ depressive symptoms [45–47]. Prior research has demonstrated high internal consistency in both community and clinical samples (Cronbach’s $\alpha=0.85$; Cronbach’s $\alpha=0.90$), and test–retest reliability (intraclass correlation between 0.45 and 0.70), for the *CES-D* [45].

FAD behaviors

The *Revised Compensatory Eating Behaviors and Behaviors in Response to Alcohol Consumption Scale (CEBRACS-R)* [48] was used to assess the participants’ FAD behaviors. This 19-item questionnaire is adapted from the original *Compensatory Eating Behaviors in Response to Alcohol Consumption Scale (CEBRACS)* [4] and has been validated for use with college samples [48]. The *CEBRACS-R* consists of three sections assessing the participant’s disordered eating behaviors and compensatory behaviors (e.g., skipping meals, restricting consumption of calories, use of dieting medications/laxatives, over-exercising or purging) prior, during, and after alcohol consumption during the past three months [48]. The *CEBRACS-R* has three subscales that assess for compensatory behaviors prior to, during, and after alcohol consumption (Bulimia, Alcohol Effects, Diet and Exercise) [48]. The Bulimia subscale assesses for compensatory behaviors such as purging, taking laxatives, or diuretics [48]. The Alcohol Effects subscale assesses only for the presence of compensatory behaviors (e.g., skipping meals, restricting caloric intake) prior or during a drinking episode to maximize the effects of alcohol [48]. The Diet and Exercise subscale assesses for weight-related compensatory behaviors such as frequent dieting or exercise [48]. Participants rated how often they engaged in the behaviors through a scale ranging from 1 (Never) -5 (Almost All the Time) [4, 48]. For scoring, items from each subscale are summed [48]. Prior research has demonstrated excellent internal consistency (Cronbach’s $\alpha=0.93$) and convergent validity for the *CEBRACS-R* [48].

Procedure

All study procedures were approved by the authors’ Institutional Review Board. Participants completed all study measures through an online cross-sectional survey via REDcap,

and inclusion criteria were assessed through online questions prior to completion of the survey. Participants indicated their consent to the study by reading an information form and clicking on the link to continue the survey. After completing the survey each participant received research credits for their participation.

Data analyses

A series of linear regressions was performed to examine whether *ACES*, *GAD-7*, and *CES-D* scores were significantly associated with *CEBRACS-R* subscale scores while controlling for alcohol use frequency. Alcohol use frequency was controlled for due to the potential relationship between FAD and frequency of alcohol use and to examine the relation between psychological distress (i.e., anxiety, depression), adverse childhood events, and FAD behaviors outside of what could be accounted for by alcohol use frequency [23, 24, 28–33, 37]. Nine linear regressions were conducted to examine whether each variable (i.e., *ACES*, *GAD-7*, *CES-D* total scores) were significantly associated with scores on the *CEBRACS-R* Alcohol Effects subscale, Bulimia subscale, and Diet and Exercise subscale. Additionally, Cronbach’s alpha for the *GAD-7*, *CES-D*, and *CEBRACS-R* was examined to determine internal consistency within the current study sample.

Results

Participants were mostly female ($n=119$, 57.5%), White ($n=157$, 75.8%), and Non-Hispanic ($n=195$, 95.2%). The majority of participants were a member of two-parent biological families ($n=168$, 81.2%), lived on campus (e.g., dorms; $n=134$, 64.7%), and were single, never married ($n=186$, 89.9%). Endorsement of depressive symptoms ranged from ‘minimal’ ($n=118$, 57%), ‘mild’ ($n=47$, 22.70%), and ‘moderate/severe’ ($n=42$, 20.30%). See Table 1 for complete participant demographics. See Table 2 for descriptive statistics on participant alcohol use, *ACES*, *GAD-7*, *CES-D*, and *CEBRACS-R* scores. Internal consistency for the *GAD-7*, *CES-D*, and *CEBRACS-R* were found to be in the acceptable range (*GAD-7*, Cronbach’s $\alpha=0.91$; *CES-D*, Cronbach’s $\alpha=0.91$; *CEBRACS-R*, Cronbach’s $\alpha=0.92$) in the current study sample. Further, internal consistency for the *CEBRACS-R* subscales were found to be acceptable (Alcohol Effects subscale, Cronbach’s $\alpha=0.96$; Bulimia subscale, Cronbach’s $\alpha=0.73$; Diet and Exercise subscale, Cronbach’s $\alpha=0.86$).

Greater current symptoms of generalized anxiety predicted greater scores on the Alcohol Effects subscale, $\beta=0.14$, $F(1, 204)=4.44$, $p=0.04$; Bulimia subscale, $\beta=0.17$, $F(1, 204)=6.29$, $p=0.01$; Diet and Exercise

Table 1 Participant demographics

Variable	<i>n</i> (%)
Gender identity	
Female	119 (57.50)
Male	88 (42.50)
Age	
18	57 (27.50)
19	103 (49.80)
20	22 (10.60)
21	13 (6.30)
> 22	4 (2.00)
Missing	8 (3.90)
Ethnicity	
Non-hispanic, non-latino	197 (95.20)
Hispanic, latino	10 (4.80)
Race	
White	157 (75.80)
Black	10 (4.80)
Asian	22 (10.60)
Multiracial	12 (5.80)
Other	6 (2.90)
Marital status	
Now married	14 (6.80)
Not married, but living with partner	7 (3.40)
Single, never married	186 (89.90)
Employment status	
Employed full-time	5 (2.40)
Employed part-time	87 (42.00)
Not employed, not looking for work	62 (30.00)
Not employed, looking for work	53 (25.60)
Current living arrangement	
On UC campus/dorms	134 (64.70)
Off-campus with parent(s)	28 (13.50)
Off-campus living alone	6 (2.90)
Off-campus living with someone who is not your parent(s)	39 (18.80)
Family composition	
Two-parent biological family	168 (81.20)
Two-parent adoptive family	2 (1.00)
Two-parent stepfamily	6 (2.90)
Single-parent biological family	24 (11.60)
Single-parent adoptive family	1 (0.50)
Other	6 (2.90)

subscale, $\beta=0.19$, $F(1, 204)=9.67$, $p<0.01$, regardless of alcohol use frequency. Number of adverse childhood experiences endorsed on the ACES predicted greater scores on the Alcohol Effects subscale, $\beta=0.14$, $F(1, 204)=4.27$, $p=0.04$, regardless of alcohol use frequency. Number of adverse childhood experiences endorsed on the ACEs did not significantly predict greater scores on the Bulimia

subscale, $\beta=-0.01$, $F(1, 204)<0.001$, $p=0.99$, or Diet and Exercise Subscale, $\beta=0.08$, $F(1, 204)=1.57$, $p=0.21$, regardless of alcohol use frequency. Greater current symptoms of depression did not significantly predict FAD behaviors regardless of alcohol frequency (i.e., Alcohol Effects subscale, $\beta=0.11$, $F(1, 204)=3.10$, $p=0.08$; Bulimia subscale, $\beta=0.08$, $F(1, 204)=1.43$, $p=0.23$; Diet and Exercise Subscale, $\beta<0.01$, $F(1, 204)=0.006$, $p=0.94$). See Table 3 for complete regression results.

Discussion

The current study is the first to explore whether adverse childhood experiences and symptoms of depression and generalized anxiety are risk factors for engagement in FAD behaviors in a high-risk sample of college students. Our study highlights the importance of examining the potential risk factors of FAD behaviors given that college students are a particular at-risk group. College students may be a particular at-risk group due to their increased engagement in maladaptive behaviors such as alcohol consumption, disordered eating behaviors, and increased engagement in binge drinking [10–14]. Overall study findings suggest that students who endorsed a greater number of symptoms of anxiety and adverse childhood experiences are more likely to engage in FAD behaviors. Unexpectedly, study findings also revealed that students, endorsing greater current symptoms of depression were not more likely to engage in FAD behaviors.

Our findings revealed that participants who endorsed greater symptoms of anxiety engaged in more compensatory behaviors to increase the effects of alcohol, regardless of the frequency of their alcohol use. This finding suggests that individuals who display elevated symptoms of anxiety may be at a greater risk to engage in compensatory behaviors (e.g., skipping meals, restricting caloric intake) to heighten the effects of alcohol. Since alcohol misuse is common in college student populations, along with the experiences of life and academic stressors [20, 49], it may be that individuals engage in these compensatory behaviors to become intoxicated faster as way for them to cope with their anxiety related to the stressors of being a college student. In line with these findings, Roosen and Mills [17] reported that anxiety symptoms predicted engagement in food restriction prior to alcohol consumption in a Canadian sample of women.

Participants who endorsed greater symptoms of anxiety also were found to have engaged in an increased amount of dieting and exercise and engage in bulimic behaviors (i.e., taking laxatives or diuretics or inducing vomiting), regardless of the frequency of their alcohol use. This finding further suggests that individuals who displayed elevated symptoms of anxiety may be at a greater risk to engage in

Table 2 Participant Scores on *ACES*, *GAD-7*, *CES-D*, *CEBRACS-R* and Frequency of Alcohol Use

Variable	Mean (standard deviation)
ACES	1.29 (1.67)
CES-D	15.73 (10.40)
GAD-7	5.71 (5.12)
CEBRACS-R Alcohol Effects	9.60 (5.18)
CEBRACS-R Bulimia	6.49 (1.54)
CEBRACS-R Diet and Exercise	8.67 (4.30)
Number of adverse childhood experiences	<i>n</i> (%)
0	93 (44.90)
1	47 (12.70)
2	29 (14.00)
3	12 (5.80)
4	13 (6.30)
5	6 (2.90)
6	5 (2.40)
7	1 (0.50)
8	1 (0.50)
Frequency of alcohol use during college	<i>n</i> (%)
Never	49 (23.70)
Less than 1–2 times a year	9 (4.30)
Once every few months	21 (10.10)
Once a month	29 (14.00)
Weekly	99 (47.80)
For participants who reported weekly alcohol use (<i>n</i> =99)	<i>n</i> (%)
1 day a week	60 (60.60)
2 days a week	27 (27.30)
3 days a week	9 (9.10)
4 days a week	1 (1.00)
5 days a week	0 (0.00)
6 days a week	1 (1.00)
7 days a week	1 (1.00)

ACES Adverse Childhood Experiences Survey, *CES-D* Center for Epidemiological Studies Depression Scale, *GAD-7* Generalized Anxiety Disorder questionnaire, *CEBRACS-R* Revised Compensatory Eating Behaviors and Behaviors in Response to Alcohol Consumption Scale

weight-related compensatory behaviors to offset the calories consumed through alcohol. Concerns regarding body image and weight gain during college is common among college students, which can be a risk factor for disordered eating behaviors [50, 51]. Additionally, since research has identified the co-occurrence of anxiety, alcohol misuse, and compensatory behaviors [17, 28], individuals who struggle with anxiety and concerns regarding body image may be more inclined to engage in these behaviors as a maladaptive coping mechanism for their anxiety symptoms. It also may be that individuals who struggle with heightened anxiety, may feel more motivated to engage in frequent dieting and exercise to after alcohol consumption to compensate and cope

from the fear of weight gain. These findings are important in that they further indicate a relationship between psychological distress (i.e., anxiety) and FAD behaviors. These findings also highlight the need for further research examining psychological distress and the role it plays in the development and maintenance of FAD behaviors.

Participants who endorsed a history of adverse childhood experiences were found to engage in more compensatory behaviors to increase the effects of alcohol, regardless of the frequency of their alcohol use. This finding may suggest that individuals who have experienced adverse events in childhood may be at a greater risk to engage in compensatory behaviors (e.g., caloric restriction, skipping meals) with

Table 3 Regression analysis: predictors, alcohol use frequency and CEBRACS-R Subscales

Source	<i>B</i>	<i>SE B</i>	β	<i>F</i>	<i>p</i>
Regressions predicting FAD behaviors to maximize alcohol effects					
<i>Regression 1: ACEs as a predictor</i>					
Constant	6.51	0.65		98.97	<.001
Alcohol use frequency	0.85	0.16	0.34	26.44	<.001
ACEs	0.42	0.20	0.13	4.27	0.04
<i>Regression 2: depressive symptoms as a predictor</i>					
Constant	6.19	0.77		64.45	<.001
Alcohol use frequency	0.82	0.16	0.33	25.17	<.001
CES-D	0.06	0.00	0.12	3.10	0.08
<i>Regression 3: anxiety symptoms as a predictor</i>					
Constant	6.34	0.69		84.84	<.001
Alcohol use frequency	0.81	0.16	0.32	24.55	<.001
GAD-7	0.14	0.07	0.14	4.44	0.04
Regressions predicting diet and exercise FAD behaviors					
<i>Regression 4: ACEs as a predictor</i>					
Constant	5.77	0.53		119.82	<.001
Alcohol use frequency	0.86	0.13	0.42	43.18	<.001
ACEs	0.21	0.16	0.08	1.57	0.21
<i>Regression 5: depressive symptoms as a predictor</i>					
Constant	6.00	0.62		92.99	<.001
Alcohol use frequency	0.86	0.13	0.42	42.73	<.001
CES-D	0.00	0.03	0.01	0.01	0.94
<i>Regression 6: anxiety symptoms as a predictor</i>					
Constant	5.21	0.54		91.65	<.001
Alcohol use frequency	0.83	0.13	0.40	41.10	<.001
GAD-7	0.16	0.05	0.19	9.67	<.001
Regressions predicting diet and exercise FAD behaviors					
<i>Regression 7: ACEs as a predictor</i>					
Constant	6.10	0.21		876.46	<.001
Alcohol use frequency	0.13	0.05	0.17	6.35	0.01
ACEs	− 0.00	0.06	− 0.00	<.001	0.99
<i>Regression 8: depressive symptoms as a predictor</i>					
Constant	5.91	0.24		600.59	<.001
Alcohol use frequency	0.13	0.05	0.17	5.98	0.02
CES-D	0.01	0.01	0.08	1.43	0.23
<i>Regression 9: anxiety symptoms as a predictor</i>					
Constant	5.83	0.21		747.89	<.001
Alcohol use frequency	0.12	0.05	0.16	5.42	0.02
GAD-7	0.05	0.02	0.17	6.29	0.01

the motivation to become intoxicated faster. These findings build upon prior research that has supported a link between adverse childhood experiences, alcohol consumption and disordered eating behaviors [23–27]. It may be that individuals who have experienced traumatic events in childhood engage in these behaviors as a potential maladaptive coping mechanism. Consistent with this finding, Rothman et al. [52] found that individuals reported engaging in alcohol use as a coping mechanism to cope with stress and tension resulting

from experiencing adverse childhood events. It is known that disordered eating prior to alcohol consumption can result in quicker intoxication but can also put individuals at risk for a number of negative alcohol-related consequences [7, 19, 22]. These findings highlight the importance of gaining a further understanding of the role that FAD behaviors may play in individuals who engage in these behaviors as a coping mechanism from experiencing adverse events in childhood.

Inconsistent with the study hypotheses, past history of adverse childhood experiences was not significantly associated with engagement in weight-related compensatory behaviors such as bulimic behaviors or engagement in frequent dieting and exercise. This was surprising as prior research has supported a link between adverse events in childhood and compensatory behaviors, such that history of past trauma was identified as a risk factor for engagement in disordered eating behaviors (e.g., restricted eating, bingeing/purging) within a college sample [27]. One potential explanation for this finding may be that individuals endorsing adverse childhood experiences have the motivation to become intoxicated quicker through the engagement of FAD behaviors but may not be experiencing other motivations (e.g., drive for thinness) prompting the engagement in FAD behaviors [2, 8, 9]. Another potential explanation for this lack of relationship is that participants in our sample reported a low frequency of adverse childhood experiences, with nearly 45% of study participants that reported experiencing no adverse childhood experiences. The limited experience of adverse childhood experiences in our sample may have limited our ability to find a relation between this variable and engagement in bulimic behaviors or frequent dieting and exercise. Low presence of adverse childhood experiences in our sample could be related to the participants in our study being a primarily non-Hispanic White sample, a population that may experience lower rates of adverse childhood experiences compared to other racial and ethnic groups [53, 54].

Contrary to the study hypotheses, greater symptoms of depression were not significantly associated with engagement in FAD behaviors (i.e., engagement in compensatory behaviors such as caloric restriction, bulimic behaviors, or engagement in excessive dieting and exercise). This finding suggests that individuals who experience elevated symptoms of depression may not be at a greater risk to engage in compensatory behaviors to compensate for calories consumed through alcohol or to increase the effects of intoxication. This finding was unexpected, as previous research has established the comorbidity between depression and disordered eating and identified similar risk factors for both disordered eating behaviors and depression [33]. Interestingly, almost half of the study sample (i.e., 43%) endorsed 'mild' to 'moderate/severe' depressive symptoms. Since almost half of the study sample endorsed elevated symptoms of depression, study results may not be explained by a lack of pathology within the study sample. However, it may be that since symptoms of depression can often include fatigue and low energy [55], participants who displayed elevated symptoms of depression may not have had the mental or physical energy to participate in exercise. This may explain the lack of association between elevated depressive symptoms and engagement in frequent

exercising as a way to compensate for calories consumed through alcohol. Similarly, dieting can also involve a lot of mental and physical energy to put forth effort into planning or deciding how one may diet. Past research has supported a link between depressive symptoms and lack of engagement in healthy dieting behaviors [56].

Conclusions

The current study is the first to explore mental health and adverse childhood experiences as possible risk factors for engagement in FAD behaviors among an at-risk group of college students. Students who had experienced higher current symptoms of anxiety displayed greater engagement in FAD behaviors. Evaluating college student's mental health, student's alcohol usage and providing access to mental health care may help prevent future engagement in FAD behaviors from occurring in a college student population. Prevention efforts to avert FAD behaviors may be particularly beneficial for college students experiencing anxiety, students who engage in frequent alcohol misuse, or students engaging in compensatory behaviors. Understanding of the role mental health and adverse childhood experiences in development and maintenance of FAD behaviors could provide clinically useful information in treating FAD behaviors.

Strengths and limits

One strength of the current study includes that it is the first to explore risk factors of engagement in FAD behaviors within a U.S. sample of college students. There are limitations of the current study that should be taken into consideration. The current study used self-report measures regarding alcohol consumption and many participants were under the age for legal consumption in the United States; therefore, participant answers to questions could have been biased. However, measures were completed anonymously, which may have reduced potential pressure to underreport underage alcohol consumption. Further, the study used a questionnaire that was created to assess frequency of alcohol use among the study sample. This questionnaire presents as a limitation due to the lack of validity and reliability of its use. Given the cross-sectional nature of the current study, we are unable to determine potential directions of causality. The study sample was small, primarily non-Hispanic White, and consisted of students taking Introduction to Psychology at an U.S. University. Therefore, study results may not generalize to other diverse groups of college students or to internationally diverse University students.

What is already known on this subject?

Food and Alcohol Disturbance (FAD) is where individuals engage in compensatory behaviors in response to alcohol consumption. Engagement in FAD behaviors is prevalent in college student populations. Risk-factors for engagement in FAD behaviors are currently unclear.

What this study adds?

Students endorsing greater symptoms of anxiety and adverse childhood experiences were more likely to engage in FAD behaviors, regardless of the frequency of their alcohol consumption. Students endorsing greater symptoms of depression were not more likely to engage in FAD behaviors.

Author contributions Taylor Gates and Cathleen Odar Stough designed the study and wrote the protocol. Taylor Gates conducted literature searches and provided summaries of previous research studies. Taylor Gates and Cathleen Odar Stough conducted the statistical analyses. Taylor Gates wrote the first draft of the manuscript and Cathleen Odar Stough contributed to and approved the final manuscript. TG: Conceptualization, Methodology, Formal analyses, Investigation, Writing—original draft, Writing—review & editing. COS: Conceptualization, Methodology, Investigation, Writing—review & editing, Supervision.

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Availability of data and material The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability Not Applicable.

Declarations

Conflict of interest All authors declare no conflicts of interest.

Ethical approval The questionnaire and methodology for this study was approved by the Institutional Review Board (IRB) of the University of Cincinnati (Ethics Approval Number: IRB Registration #: 00000180 FWA #: 000003152).

Informed consent Informed consent was obtained from all individual participants included in the study.

Consent for publication Informed consent for publication and dissemination of results was obtained from all individual participants included in the study.

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