

Momentary predictors of binge eating episodes and heavy drinking episodes in individuals with comorbid binge eating and heavy drinking

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Abstract

Purpose – The co-morbidity of binge eating and heavy drinking (BE+HD) is a serious concern due to the high prevalence rates and associated elevated severity. Clarifying the momentary factors that increase risk for binge eating and heavy drinking among BE+HD is important for expanding theoretical models of BE+HD and informing treatment recommendations. The current study used ecological momentary assessment (EMA) to compare the momentary processes maintaining binge eating between BE+HD and individuals with binge eating only (BE-only) and to identify the momentary risk factors for binge eating episodes and heavy drinking episodes among BE+HD.

Methods – Participants (BE+HD: $N = 14$; BE-only: $N = 37$) were adults with clinically-significant binge eating who completed between 7 – 14 days of EMA prior to treatment.

Results – The presence of food and within-day dietary restraint predicted higher odds of binge eating for both groups. Among BE+HD, the presence of alcohol and dietary restraint increased risk for subsequent binge eating and subsequent heavy drinking, and the absence of food increased risk for subsequent heavy drinking.

Conclusion - These results offer preliminary support for treatment interventions for BE+HD that focus on reducing dietary restraint and teaching strategies for urge management in situations with palatable food or alcohol. Future research should study the maintenance mechanisms of BE+HD with larger, more diverse samples and using study design approaches with more experimenter control (i.e., laboratory experiments).

Level of Evidence: Level IV, multiple time series without intervention

What Is Already Known On This Subject?

Individuals with binge eating often engage in heavy drinking, and the comorbidity of binge eating and heavy drinking (BE+HD) is associated with negative psychosocial consequences and increased alcohol severity. Previous studies have implicated affect, social context, the presence of food and alcohol, and prolonged dietary restraint as potential momentary risk factors that contribute to the maintenance of BE+HD. However, no study has used ecological momentary assessment to evaluate whether these momentary factors increase risk for subsequent binge eating episodes or heavy drinking episodes in BE+HD.

What this study adds?

Results from the current study identifies the presence of food and alcohol and prolonged dietary restraint as momentary risk factors for binge eating and heavy drinking in BE+HD. Future research is needed to evaluate whether targeting these momentary maintenance processes may improve treatment outcomes for BE+HD.

Introduction

Binge eating (i.e., the experience of loss of control over eating behavior) is a core behavioral feature of eating disorders such as bulimia nervosa and binge eating disorder. Binge eating also co-occurs frequently with problematic alcohol use. Individuals with binge eating report more heavy drinking episodes (i.e., the consumption of three or more alcoholic drinks in a distinct time period) [1] than individuals without binge eating [2]. The comorbidity of binge eating and heavy drinking (BE + HD) is a serious concern because it is associated with increased psychosocial consequences and higher alcohol severity [3–6]. Given the high prevalence and associated severity, it is important to identify the underlying mechanisms maintaining BE + HD to inform treatment recommendations.

The vast majority of research on maintenance factors of BE + HD has been conducted using cross-sectional methods, which are limited by assessing behavior at only one time point and in one context (i.e., a lab setting) and due to the potential inaccuracies of memory recall [7, 8]. Ecological momentary assessment (EMA) may address some of the limitations of cross-sectional research through repeated assessment of experiences in real-time, real-world settings. By using multiple assessment points throughout the day, researchers are able to examine sequences of events and experiences that influence behavior and gather ecologically valid observations that are generalizable to an individual's daily experiences [7].

Prior literature suggests a few promising avenues for EMA research aiming to identify maintenance factors of BE + HD. First, theoretical models posit that the underlying traits associated with BE + HD (e.g., impulsivity, reward sensitivity, affect dysregulation) increase one's vulnerability for binge eating or heavy drinking in response to momentary cues [9]. Based on these models, it can be hypothesized that individuals with BE + HD are more reactive and more likely to engage in binge eating or heavy drinking in response to urges that arise from internal or external cues (e.g., affect, social context, presence of food or alcohol, dietary restraint) compared to individuals with binge eating only (BE-only). However, given that no study to date tested these theoretical maintenance models (Fig. 1), research using EMA is needed to confirm if the momentary maintenance processes of BE + HD differ from the processes maintaining BE-only.

Second, the literature on maintenance factors of BE + HD suggests that affect, social context, the presence of food or alcohol, and prolonged dietary restraint (i.e., attempting to restrict dietary intake across the day) might be momentary risk factors for binge eating or heavy drinking episodes. To date, there have been three studies examining the momentary processes that promote binge eating or heavy drinking in co-morbid samples [10, 11, 4]. Pissetsky and colleagues (2016) used EMA to examine the temporal association between affect and self-reported alcohol intoxication among women with bulimia nervosa and found that positive affect significantly decreased in the hours prior to alcohol intoxication. Additionally, in two cross-sectional studies that assessed situational factors associated with binge eating and heavy drinking episodes among women with BE + HD [10, 4], results found that heavy drinking episodes occurred more often than binge eating episodes in situations with positive emotions or in social

situations, and both binge eating and heavy drinking episodes were likely to occur in situations involving behavior-specific temptations (e.g., presence of food or alcohol). While these studies highlight some potential internal and external factors to consider for BE + HD, further research using EMA is needed to identify the specific momentary factors that increase risk for binge eating episodes and heavy drinking episodes in BE + HD.

Given the limited research among BE + HD, a review of the larger body of EMA research in binge eating-only samples and heavy drinking-only samples (BE-only; HD-only) is necessary to inform specific hypotheses regarding momentary risk factors. Two main findings from this literature should be highlighted. First, some differential patterns have been observed between the momentary risk factors for binge eating and the momentary risk factors for heavy drinking that may also be present within BE + HD. Increased negative affect, being alone, and the presence of food were each identified as risk factors for subsequent binge eating [12–16], while increased positive affect, being with others, and the presence of alcohol were each identified as risk factors for subsequent heavy drinking [17, 18]. Meanwhile, the presence of prolonged dietary restraint was noted as a risk factor for both binge eating episodes and heavy drinking episodes [19–21]. Second, the length of time between the momentary risk factors and subsequent binge eating or heavy drinking varied depending on the maintenance factor. Affect, social context, and presence of food or alcohol were each noted as near-time risk factors (i.e., present within 3–4 hours preceding binge eating or heavy drinking), while the presence of dietary restraint was noted as a within-day risk factor (i.e., present on the same day as binge eating or heavy drinking). Based on this research, it can be hypothesized that among BE + HD, elevated negative affect, being alone, the presence of palatable foods, and within-day dietary restraint are each momentary risk factors for binge eating, and that elevated positive affect, being with other people, the presence of alcohol, and within-day dietary restraint are each momentary risk factors for heavy drinking. However, given that only one study has used EMA to identify momentary predictors of heavy drinking among BE + HD (Pisetsky et al., 2016) and no study has used EMA to identify momentary predictors of binge eating among BE + HD, more EMA research is needed to identify the momentary risk factors of binge eating and heavy drinking episodes in BE + HD. If the hypothesized momentary predictors are supported through EMA research, these results would suggest specific treatment targets for BE + HD.

Current Study

The current study included a subset of participants from a larger parent study that used EMA to identify momentary risk factors of eating disorder behaviors among individuals with clinically significant binge eating pathology prior to starting a treatment-based research study. The current study aimed to test the following hypotheses: (1) individuals with BE + HD are at a higher risk for binge eating in response to momentary risk factors (i.e., increased negative affect, being alone, presence of food, within-day dietary restraint) than individuals with BE-only, (2) among individuals with BE + HD, increased negative affect, being alone, and the presence of palatable foods will each significantly predict greater odds of subsequent binge eating episodes, and within-day dietary restraint will predict greater odds of same-day

binge eating, and (3) among individuals with BE + HD, increased positive affect, being with others, and the presence of alcohol will each significantly predict greater odds of subsequent heavy drinking episodes, and within-day dietary restraint will predict greater odds of same-day heavy drinking. Since binge eating and heavy drinking may occur simultaneously, exploratory analyses were conducted to characterize the momentary precipitants of simultaneous binge eating and heavy drinking episodes.

Methods

Participants

The current study included a sample of 53 participants from the parent study who had completed EMA items on heavy drinking behaviors. Participants were included in the parent study if they met the following criteria: 1) are 18 years of age or older, 2) experience at least one binge eating episode per week on average over the past 12 weeks, 3) have a smartphone and are willing to complete surveys on it for the course of the study, 4) are enrolled to participate in a treatment-based study at the university research center and have at least 7 days before their first treatment session, 5) are located in the United States and are willing and able to participate in remote intervention and assessments. Individuals were excluded if they were 1) unable to fluently speak, write, and read English, 2), pregnant or planning to become pregnant, 3) are currently participating in, or are planning to begin, another psychotherapy for binge eating or a structured weight loss treatment, 4) have an intellectual disability or are currently experiencing other severe psychopathology that would limit their ability to engage in the treatment program (e.g., severe depression, active substance use disorder, active psychotic disorder), or 5) are unable or unwilling to consistently complete 6 mobile surveys between the hours of 9:00am and 9:00pm.

Procedure

Participants who met the inclusion criteria were invited to participate in the current study prior to beginning a treatment-based study at the research center. Participants completed an initial 30-minute appointment to set up the EMA smartphone app and received instruction about relevant constructs included in the EMA surveys (e.g., DSM-5 definition of binge eating episode, NIAAA guidelines for the size of a standard alcoholic drink). Participants completed between 7 to 14 days of the EMA protocol. During the EMA protocol, participants received 6 semi-random surveys per day (i.e., signal-contingent surveys; approximately 3 surveys in the morning and 3 surveys in the afternoon/evening). Participants were also instructed to complete a survey after engaging in an eating disorder behavior (i.e., event-contingent survey). Participants were financially compensated for their participation in the study. To encourage EMA compliance, compensation was reduced for missed surveys, and participant had the opportunity to earn additional compensation by completing 85% or more of all surveys. The parent study procedures were approved and overseen by the university Institutional Review Board. All participants provided informed consent before participating.

Measures

Affect. Participants rated their current affective state using a 5-point scale ranging from 0 (not at all) to 4 (extremely) on four negative affect items (i.e., Guilt, Sadness, Anxiety, Boredom) and two positive affect items (i.e., Cheerfulness, Excitedness). Average negative affect and average positive affect for each survey point was calculated. EMA items were chosen from the Positive and Negative Affect Scale [22] based on previous work with EMA in binge eating or heavy drinking samples [23, 14].

Social Context. Participants were asked to select one of the following options for their primary social context since the previous survey: (a) with friends/family, (b) around strangers, or (c) alone. For the current study, participant's responses were dichotomized into two categories: (1) with others (i.e., with friends/family or around strangers) or (2) alone. The EMA item for social context used in the current study is consistent with EMA items used in the eating disorder and substance use disorder field [24–26].

Presence of Food or Alcohol. Participants reported whether alcohol or good tasting high-calorie foods were available to them (i.e., visible and easily accessible) since the previous survey in two dichotomous EMA items. These EMA items are consistent with items used to assess presence of palatable foods or presence of alcohol in previous EMA work (Ramirez & Miranda, 2014; Thomas et al., 2011).

Dietary Restraint. Participants were asked to select any dietary restraint behaviors (i.e., limiting food intake, delaying eating, avoiding eating certain foods) they have attempted to engage in since the previous surveys whether or not they were successful. Presence of within-day dietary restraint was categorized as endorsement of at least one of the three dietary restraint behaviors on a given day. The EMA item for dietary restraint used in the current study is consistent with EMA items used in the eating disorder field (Rodgers et al., 2018).

Presence of Binge Eating. Participants were asked to report whether they experienced a binge eating episode, defined as “loss of control over your eating, or the sense that you can't stop eating once you start eating and/or that you can't control what or how much you're eating”, since the last survey or to self-initiate an EMA survey following the occurrence of binge eating. This approach for assessing binge eating through EMA is consistent with other EMA studies in the eating disorder field [27, 28].

Presence of Heavy Drinking. Participants were asked to report if they drank three or more alcoholic drinks since the previous survey, as per NIAAA definition of heavy drinking [1]. The EMA item for heavy drinking used in the current study was consistent with EMA items used to assess alcohol use in previous studies [29]. Participants were also provided with the NIAAA guidelines for the quantity of alcohol in a standard drink at the baseline assessment.

Data Analytic Strategy

Statistical Power. In EMA research, the number of observations of behavior (e.g., binge eating, heavy drinking) is an important component of the sample size in addition to the number of participants. Among the 51 participants included in the final analyses (after removing 2 participants due to poor EMA compliance), 382 binge eating episodes and 75 heavy drinking episodes were reported. Power analyses were not able to be conducted for Aim 1 given that there is no specific formula to estimate the sample size for interaction tests in multilevel models (Scherbaum & Pesner, 2019). For Aims 2 and 3, post hoc power analyses conducted using the EMAtools package for R version 4.0.5 [30] found that the current sample of 14 participants with BE + HD who completed a maximum of 6 surveys per day for 14 days, with on average 75% compliance, would result in adequate statistical power ($1 - \beta = .80$) to detect medium effect sizes in the multilevel models. Odds ratios were also reported as measures of effect size to aid interpretation of results.

Study Aims. All analyses were conducted using IBM SPSS 26.0. Two participants were removed from analyses due to poor compliance with the EMA protocol (i.e., missed more than 50% of survey prompts). BE + HD and BE-only groups were compared on baseline characteristics, predictor variables, and dependent variables using independent samples *t*-tests and chi-square tests of independence. Negative binomial generalized linear mixed models (GLMMs) were conducted to test the three primary study aims. Continuous independent variables (i.e., negative affect, positive affect) were person mean-centered to account for within-person effects. Subjects were included as random effects within the model, and a standard variance components covariance structure was used for random effects. Prior binge eating episodes on the same day were included in the models as covariates. Odds ratios were calculated as a measure of effect size for each analysis. Given the difficulty of interpreting odds ratios, ranges for small, medium, and large effect sizes were calculated based on Cohen's *d* effect size ranges using methods described by Chen, Cohen, and Chen (Chen et al., 2010). OR benchmarks for each model are included in the results tables. For the exploratory aim, descriptive statistics for the frequency and momentary precipitants of simultaneous binge eating and heavy drinking episodes were calculated.

Results

Sample Characteristics

Baseline characteristics of the analytic sample ($N = 51$) and group differences are reported in Table 1. The sample included 3330 EMA surveys. Participants completed between 6–14 days of EMA ($M = 12.33$, $SD = 2.06$). Mean compliance for prompted EMA surveys was 87.49% ($SD = 10.94\%$), comparable to other EMA studies in the eating disorder field (Schaefer et al., 2020; Smith, Mason, Schaefer, et al., 2020; Srivastava, Felonis, et al., 2021; Srivastava, Michael, et al., 2021). Group status was determined based on the presence of heavy drinking during the EMA period; therefore, 14 participants were classified as BE + HD and 37 participants were classified as BE-only.

Table 1
Descriptive Statistics of EMA Dependent Variables and Predictors.

Demographics					
EMA Items	BE + HD (N = 14)	BE-only (N = 37)	Total (N = 51)	t	χ²
Biological Sex (<i>N</i> , %)	5 (35.7%)	7 (18.9%)	12 (23.5%)		1.59
Male	9 (64.3%)	30 (81.1%)			
Female			39 (76.5%)		
Age (<i>M</i> , <i>SD</i>)	39.86 (13.06)	38.81 (12.22)	39.10 (12.34)	-.27	
Race (<i>N</i> , %)	7 (50.0%)	25 (67.6%)	32 (62.7%)		1.34
White	2 (14.3%)	3 (8.1%)	5 (9.8%)		
Black/African American	2 (14.3%)	1 (2.7%)	3 (5.9%)		
Asian American	1 (7.1%)	0 (0.0%)	1 (2.0%)		
American Indian/Alaskan	2 (14.3%)	5 (13.5%)	7 (13.7%)		
More than one race	0 (0.0%)	3 (8.1%)	3 (5.9%)		
Unknown					
Ethnicity (<i>N</i> , % Hispanic or Latino)	1 (7.1%)	5 (13.5%)	6 (11.8%)		.40
Eating Disorder Diagnoses (<i>N</i> , %)	3 (21.4%)	11 (29.7%)	14 (26.4%)		1.09
Binge eating Disorder	4 (28.6%)	9 (24.3%)	13 (24.5%)		
Bulimia Nervosa	2 (14.3%)	8 (21.6%)	10 (19.6%)		
OSFED - BED	5 (35.7%)	9 (24.3%)	14 (27.5%)		
OSFED - BN					
EMA Items					
Binge Eating Episodes (<i>N</i>, % of Surveys)	94 (9.38%)	288 (12.37%)	382 (11.47%)		6.17
Heavy Drinking Episodes (<i>N</i> , % of Surveys)	75 (7.49%)	-	75 (2.25%)		
Negative Affect (<i>M</i> , <i>SD</i>)	1.59 (0.70)	1.74 (0.61)	1.69 (0.64)	1.63	

Demographics				
Positive Affect (M, SD)	1.76 (0.91)	1.34 (0.65)	1.47 (0.76)	-7.20
Social Context (M % of Surveys "With Others", SD)	58.88% (24.37%)	54.57% (24.30%)	55.87% (24.40%)	4.43
Presence of Food (M % of Surveys "Yes", SD)	72.41% (24.88%)	62.72% (29.11%)	65.64% (28.25%)	35.37
Presence of Alcohol (M % of Surveys "Yes", SD)	57.30% (27.46%)	44.36% (37.29%)	48.26% (35.13%)	51.32
Within-Day Dietary Restraint (M % of Days "Yes", SD)	78.21% (41.40%)	77.30% (41.94%)	77.57% (41.74%)	0.06

Significant differences between groups (p -values < .05) are in bold type font.

Abbreviations: OSFED-BED, Other Specified Feeding and Eating Disorder Binge eating Disorder of low frequency; OSFED-BN, Other Specified Feeding and Eating Disorder Bulimia Nervosa of low frequency.

Note: For the chi-square tests of independence comparing groups on racial status, racial status was dichotomized to White and Non-White racial statuses.

Although participants reported a total of 382 binge eating episodes and 75 heavy drinking episodes, some episodes of binge eating and heavy drinking were excluded from statistical models due to either missing data at the previous survey, episodes of binge eating or heavy drinking occurring at the first survey of the day, or binge eating or heavy drinking episodes occurring after midnight. Overall, 64.89% ($n = 61$) binge eating episodes from the BE + HD group and 62.15% ($n = 179$) binge eating episodes from the BE-only group were included in the models predicting binge eating, and 52.0% ($n = 39$) of heavy drinking episodes from the BE + HD group were included in models predicting heavy drinking.

Primary Study Aims

Results and odds ratios for Aim 1 are presented in Tables 2 and 3, and results for Aims 2 and 3 are reported in Table 4.

Table 2
Summary of Primary Aim 1 Results

Model Summary	Predictors	Coef.	SE	<i>t</i>	<i>p</i>
<i>Model 1</i> N = 2002 AIC = 10746.69	Negative Affect	-0.17	0.16	-1.09	0.27
	Negative Affect x Comorbidity	0.24	0.26	0.94	0.35
<i>Model 2</i> N = 1986 AIC = 10663.74	Social Context	-0.25	0.20	-1.24	0.21
	Social Context x Comorbidity	0.40	0.33	1.21	0.22
<i>Model 3</i> N = 1985 AIC = 10670.24	Presence of Food	0.50	0.22	2.26	0.02
	Presence of Food x Comorbidity	-0.08	0.36	-0.23	0.82
<i>Model 4</i> N = 602 AIC = 2763.73	Dietary Restraint	1.50	0.33	4.49	< .001
	Dietary Restraint x Comorbidity	-0.49	0.41	-1.17	0.24
Abbreviations: AIC, Akaike information criterion; Coef., coefficient; SE, standard error					
Significant <i>p</i> -values are in bold type font.					

Table 3
Odds Ratios for Primary Aim 1 Results.

Predictor	Group	OR	95% CI of OR	
			CI Lower	CI Upper
Negative Affect	BE-only	0.842	0.618	1.147
	BE + HD	1.072	0.474	2.424
Social Context	BE-only	0.782	0.530	1.153
	BE + HD	1.164	0.415	3.266
Presence of Food	BE-only	1.648*	1.068	2.542
	BE + HD	1.515*	0.482	4.768
Dietary Restraint	BE-only	4.474‡	2.323	8.617
	BE + HD	2.754†	0.634	11.967
Abbreviations: OR, odds ratio; CI, confidence interval				
Significant <i>p</i> -values are in bold type font.				
OR Benchmarks for Negative Affect, Social Context, and Presence of Food: * small effect (OR ≥ 1.450 or OR ≤ 0.690); † medium effect (OR ≥ 2.455 or OR ≤ 0.407); ‡ large effect (OR ≥ 4.045 or OR ≤ 0.247)				
OR Benchmarks for Dietary Restraint: * small effect (OR ≥ 1.380 or OR ≤ 0.725); † medium effect (OR ≥ 2.228 or OR ≤ 0.449); ‡ large effect (OR ≥ 3.617 or OR ≤ 0.276)				

Table 4
Summary of Primary Aims 2 and 3 Results (N = 14)

DV	Model Summary	Predictors	Coef	SE	<i>t</i>	<i>p</i>	OR	95% CI of OR		
								CI Lower	CI Upper	
Binge Eating Episodes	<i>Model 1</i> N = 594 AIC = 3311.01	Negative Affect	0.01	0.24	0.06	0.96	1.014	0.628	1.636	
		Positive Affect	-0.15	0.22	-0.71	0.48	0.858	0.562	1.309	
		Social Context	0.13	0.34	0.38	0.71	1.138	0.583	2.219	
		Presence of Food	0.29	0.55	0.53	0.60	1.340	0.454	3.955	
		Presence of Alcohol	0.64	0.41	1.56	0.12	1.902*	0.845	4.282	
	<i>Model 2</i> N = 179 AIC = 865.55	Dietary Restraint	1.55	0.80	1.93	0.06	4.694‡	0.965	22.837	
	Heavy Drinking Episodes	<i>Model 3</i> N = 594 AIC = 3510.90	Negative Affect	-0.08	0.39	-0.21	0.83	0.921	0.428	1.981
			Positive Affect	-0.40	0.31	-1.31	0.19	0.670	0.368	1.220
			Social Context	0.34	0.42	0.81	0.42	1.406	0.616	3.21
			Presence of Food	-1.50	0.63	-2.38	0.02	0.224†	0.065	0.770
Presence of Alcohol			2.27	0.66	3.46	<.001	9.650‡	2.659	35.012	
<i>Model 4</i> N = 179 AIC = 841.78	Dietary Restraint	0.50	0.53	0.93	0.35	1.643*	0.572	4.716		

Abbreviations: DV, dependent variable; AIC, Akaike information criterion; Coef, coefficient; SE, standard error; OR, odds ratio; CI, confidence interval.

Significant *p*-values are in bold type font.

OR Benchmarks for Model 1: * small effect (OR ≥ 1.450 or OR ≤ 0.690); † medium effect (OR ≥ 2.455 or OR ≤ 0.407); ‡ large effect (OR ≥ 4.045 or OR ≤ 0.247)

OR Benchmarks for Model 2: * small effect (OR \geq 1.380 or OR \leq 0.725); † medium effect (OR \geq 2.228 or OR \leq 0.449); ‡ large effect (OR \geq 3.617 or OR \leq 0.276)

OR Benchmarks for Model 3: * small effect (OR \geq 1.601 or OR \leq 0.625); † medium effect (OR \geq 3.078 or OR \leq 0.335); ‡ large effect (OR \geq 5.595 or OR \leq 0.179)

OR Benchmarks for Model 4: * small effect (OR \geq 1.465 or OR \leq 0.683); † medium effect (OR \geq 2.509 or OR \leq 0.398); ‡ large effect (OR \geq 4.167 or OR \leq 0.240)

Exploratory Aim

5 participants in the BE+HD group (35.71%) reported a total of 19 simultaneous binge eating and heavy drinking episodes. 3 of the 5 participants reported one simultaneous binge eating and heavy drinking episodes, 1 participant reported 3 episodes, and 1 participant reported 13 episodes. 10 of the 19 episodes were excluded from analyses due to missing data at the prior survey ($n = 4$) or being the first survey of the day ($n = 6$). Descriptive statistics of momentary risk factors at the surveys prior to simultaneous binge eating and heavy drinking episodes is reported in Table 5.

Table 5. Descriptive Statistics for Exploratory Aim in BE+HD.

Momentary Risk Factors at Preceding Survey <i>M</i> (SD)	Simultaneous Binge Eating and Heavy Drinking Episodes ($n = 9$)	Binge Eating Episodes ($n = 55$)	Heavy Drinking Episodes ($n = 30$)
Negative Affect (person mean-centered)	0.05 (0.49)	-0.04 (0.74)	-0.10 (0.50)
Positive Affect (person mean-centered)	0.35 (0.87)	0.07 (0.80)	0.16 (0.73)
Social Context	0.89 (0.33)	0.64 (0.49)	0.66 (0.48)
Presence of Food	0.78 (0.44)	0.89 (0.78)	0.76 (0.44)
Presence of Alcohol	0.89 (0.33)	0.67 (0.47)	0.83 (0.38)
Within-Day Dietary Restraint	1.00 (0.00)	0.91 (0.29)	0.79 (0.41)

Discussion

Comparing Momentary Predictors of Binge Eating between Groups

The current study aimed to identify and compare the momentary predictors of binge eating episodes and heavy drinking episodes among individuals with co-morbid binge eating and heavy drinking (BE+HD). The results indicate that the strength of the relationship between momentary risk factors, in particular the presence of food and the presence of within-day dietary restraint, and risk for subsequent binge eating

episodes were either equivalent between groups or stronger for the BE-only group compared to the BE+HD group. These results differ from theoretical models suggesting that the underlying traits associated with BE+HD (e.g., impulsivity, reward sensitivity, affect dysregulation) result in a higher susceptibility for binge eating in response to momentary risk factors compared to BE-only. One possibility is that individuals with BE+HD exhibit varying levels of these underlying traits and that there is a subset of individuals with BE+HD that are at a higher risk for binge eating in response to momentary cues. Future research should investigate if individuals with BE+HD scoring higher on these underlying traits (e.g., more impulsive, more sensitive to rewards) are more likely to binge eat following momentary risk factors.

Although the hypothesized moderation model was not supported by the study results, an important finding to highlight is that the presence of food and the presence of dietary restraint were related to increased odds for binge eating for both BE+HD and BE-only. These results suggest that the processes through which the presence of food and dietary restraint maintain binge eating in individuals with BE-only also contributes to the maintenance of binge eating for individuals with BE+HD (Sobik et al., 2005; Stice, 2001). These results may indicate that treatments such as Cognitive Behavioral Therapy for binge eating (CBT-E), which targets dietary restraint and urges to binge eat when palatable foods are available, will likely also be effective at reducing binge eating for BE+HD [31]. There is preliminary research to support that CBT-E improves eating disorder symptomology for individuals with BE+HD (Karačić et al., 2011). However, given the limited number of studies on treatment effectiveness for patients with BE+HD, further research is needed to assess if clinical interventions targeting dietary restraint and urges to binge eat when in the presence of palatable foods improve binge eating outcomes for individuals with BE+HD.

Predictors of Binge Eating and Heavy Drinking among BE+HD

While results are preliminary and require replication, our findings suggest some potential high-risk situations that could be targeted in clinical interventions. For example, results found that situations where alcohol was easily accessible increased the risk for binge eating and heavy drinking for BE+HD. One possibility is that the presence of alcohol increased risk for binge eating and heavy drinking by lowering inhibitions. Exposure to alcohol cues (e.g., pictures of alcohol, alcohol smells) has been shown to negatively impact inhibitory control in non-clinical samples [32,33], which could result in difficulty resisting urges to binge eat or drink and greater risk for subsequent binge eating and heavy drinking for individuals with BE+HD. Alternatively, surveys when participants reported the presence of alcohol could be an indicator of modest alcohol use (e.g., consuming one or two alcoholic drinks). Modest alcohol consumption has been shown to “prime” an individual to consume more alcohol [34] and may increase risk heavy drinking in BE+HD. Furthermore, research from nonclinical samples demonstrates an effect of modest alcohol consumption on elevated hunger [35,36], which could increase urges to binge eat among BE+HD. Since the current study did not measure modest alcohol consumption, surveys when participants endorsed the presence of alcohol may also capture modest drinking episodes that did not reach heavy drinking levels (i.e., three or more alcoholic drinks), and this modest alcohol consumption could have increased risk for binge eating and heavy drinking. Whether directly or indirectly, our findings suggest that situations where alcohol is present are particularly high-risk for individuals with BE+HD. Since the

presence of alcohol was reported at more than 50% of surveys by individuals with BE+HD in our study, limiting access to alcohol in one's daily environment may be a useful clinical intervention to reduce risk for binge eating and heavy drinking for BE+HD. Further research should clarify whether the presence of alcohol alone, without alcohol consumption, increases binge eating and heavy drinking risk, and investigate whether clinical interventions that target the availability of alcohol in one's environment impact treatment outcomes for BE+HD.

Even though individuals with BE+HD reported the presence of food more frequently than BE-only, having palatable foods accessible did not increase risk for subsequent binge eating for BE+HD as we originally anticipated. Instead, instances when individuals with BE+HD reported the absence of palatable foods were associated with a higher likelihood of heavy drinking. These results suggest that individuals with BE+HD may be more likely to turn to heavy drinking when binge eating foods are not available. It is also possible that a combination of momentary factors may increase risk for heavy drinking. For example, individuals with BE+HD may be more likely to engage in heavy drinking in situations when palatable foods are not available and alcohol is available. Other factors such as affect or social context may also contribute risk for heavy drinking during times when palatable foods are not available. Future research should aim to identify specific high-risk situations for BE+HD by testing the interactive effects of momentary risk factors on subsequent binge eating or heavy drinking.

Consistent with studies conducted among BE-only and HD-only, the current study found that attempting to restrict dietary intake on a given day was related to a higher likelihood of same-day binge eating and same-day heavy drinking for individuals with BE+HD. While we previously noted the potential benefit of treatments that target dietary restraint (e.g., CBT-E) for reducing binge eating among BE+HD, these findings suggest that treatments that target dietary restraint may also be beneficial for improving heavy drinking outcomes. In the one study to date testing the effectiveness of CBT-E on alcohol outcomes, individuals with BE+HD reported significantly greater reductions in alcohol intake at the end of treatment than BE-only (Karačić et al., 2011). It is important to note that almost 50% of patients with BE+HD in this study were still engaging in high levels of heavy drinking at the end of treatment even though their alcohol intake had decreased (Karačić et al., 2011). Therefore, although treatments targeting dietary restraint such as CBT-E show promise for improving heavy drinking outcomes in BE+HD, these treatments may need to include other relevant treatment targets (e.g., urges when alcohol is present) to affect clinically meaningful change in BE+HD.

Contrary to our initial hypotheses, affect and social context were not predictive of subsequent binge eating or heavy drinking episodes for individuals with BE+HD. These results were surprising given previous cross-sectional findings that affect was associated with risk for binge eating and heavy drinking in women with BE+HD (Birch et al., 2007). We considered a few possible explanations for these results. First, there was limited variability in affect ratings among BE+HD in our sample, which may preclude our ability to detect significant results. Second, affect was measured using a small number of EMA items (i.e., four items for negative affect, two items for positive affect) and may not have captured other relevant affective experiences (e.g., irritability, shame). Third, although social context was identified as a potential

momentary risk factor given prior research in binge eating and heavy drinking literature, assessing specific environmental stressors (e.g., parties, holiday events, bars, restaurants) may provide better insight into risk factors for binge eating or heavy drinking. Overall, research with a larger sample using more affective and environmental EMA items should be conducted to understand how affect and social context impact risk for binge eating and heavy drinking among BE+HD.

Simultaneous Binge Eating and Heavy Drinking Episodes

The current study included an exploratory aim to characterize the frequency and momentary precipitants of simultaneous binge eating and heavy drinking episodes. At the surveys prior to simultaneous binge eating and heavy drinking episodes, individuals with BE+HD reported greater increases in negative affect and greater increases in positive affect (relative to their average affect ratings) and were more likely to report being with other people compared to surveys prior to non-simultaneous binge eating or heavy drinking episodes. Additionally, individuals with BE+HD reported similar rates of presence of food and presence of alcohol prior to simultaneous binge eating and heavy drinking episodes and prior to heavy drinking-only episodes. While these preliminary results suggest that momentary predictors of simultaneous binge eating and heavy drinking episodes may differ from non-simultaneous episodes among BE+HD, it is important to note that 7 of the 9 simultaneous episodes that were included in analyses were from one participant so findings may be influenced by individual factors. Future research testing momentary precipitants of simultaneous binge eating and heavy drinking episodes should consider targeted recruitment of individuals with co-occurring binge eating and heavy drinking to increase statistical power for analyses.

Limitations and Future Directions

Strengths of the current study include the use of EMA for measuring risk factors and behavior. By using repeated assessments administered multiple times a day, our study was able to examine the micro-processes maintaining binge eating and heavy drinking behavior, which is necessary for informing clinical intervention targets. The use of EMA also improved the validity and generalizability of the data, as participants were less prone to the inaccuracies of memory recall that occur in retrospective self-reports. An additional strength of the study was the focus on heavy drinking episodes (i.e., three or more alcoholic drinks in one sitting). While heavy drinking is considered less pathological than a DSM-5 alcohol use disorder or drinking episodes involving a higher quantity of alcohol (e.g., binge drinking, high-intensity drinking), the high prevalence and negative consequences associated with comorbid binge eating and heavy drinking supported the clinical relevance of studying heavy drinking in the current study.

The results of the study should be interpreted in the context of the study's limitations. The statistical power of the current study was limited by the sample size and by the high percentage of binge eating and heavy drinking episodes not included in statistical models due to either missing data at the previous survey and binge eating or heavy drinking occurring at the first survey of the day. Another limitation was that the BE+HD group was defined by presence of heavy drinking during the EMA period, rather than through clinical interview of past drinking behavior. By choosing to define BE+HD based on data gathered

through the EMA, some participants in the BE-only group may have engaged in heavy drinking recently (e.g., in the past month) but not during the EMA period, which could have reduced our ability to detect differences between groups. Future research may consider assessing BE+HD through semi-structured clinical interviews administered at baseline (e.g., Alcohol Timeline Followback; Structured Clinical Interview for DSM-5). While the use of EMA has many benefits, one limitation of EMA is the reliance on participants to accurately self-report binge eating and heavy drinking episodes. Participants may have difficulty identifying instances of loss of control during eating or quantifying amount of alcohol consumed, and therefore may misreport binge eating and heavy drinking episodes. Experimental study designs involving clinician-rated loss of control and standardization of alcohol consumed may be beneficial for objectively measuring binge eating and heavy drinking and minimizing risk for missing data. Lastly, the generalizability of our results is limited by the homogeneity of the current sample (i.e., primarily White and female). Future research should aim to replicate the current study's results using a larger, more diverse sample of individuals with BE+HD.

Strengths and Limits

The current study was strengthened by its use of ecological momentary assessment for identifying momentary predictors of behavior and by its focus on heavy drinking, a clinically relevant problematic alcohol use behavior that occurs frequently among individuals with binge eating. Limitations of the current study include reduced statistical power, the absence of a clinical interview of alcohol use, the subjective measurement of binge eating and heavy drinking through participant self-report, and the homogeneity of the sample.

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Ethics Approval: The study was approved and overseen by the Drexel University Institutional Review Board (IRB Protocol # 2005007836), and all participants provided informed consent and were compensated for their participation.

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Figures

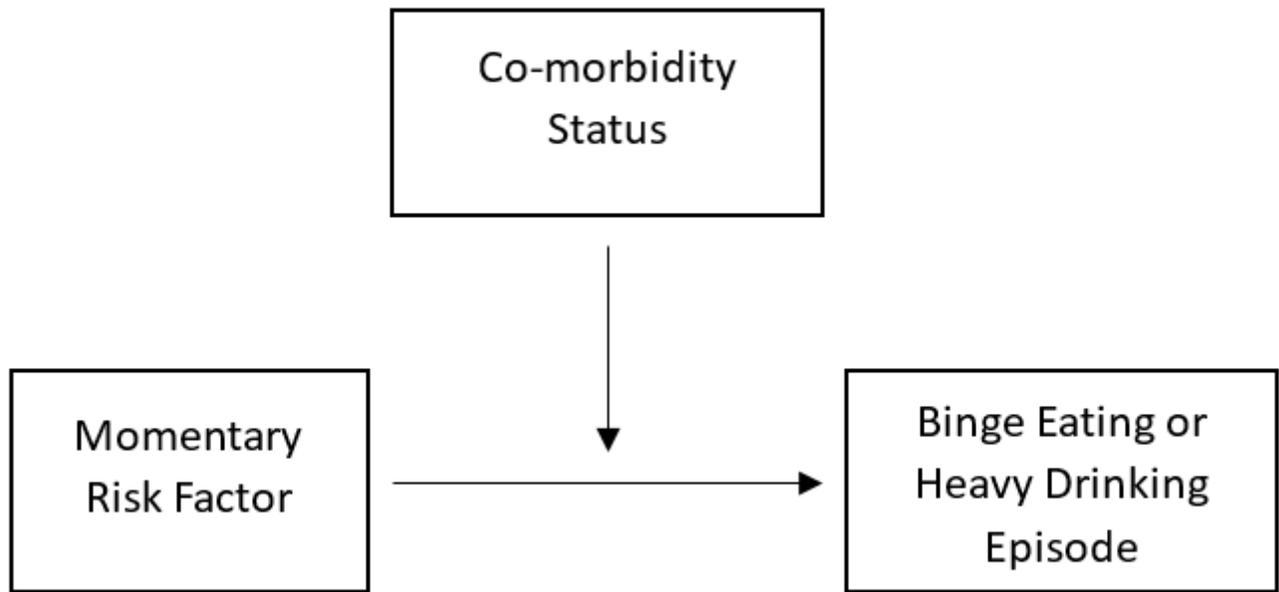


Figure 1

Hypothesized Maintenance Model of BE+HD