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ORIGINAL ARTICLE

Factorial Support and Measurement Invariance of the College Eating and Drinking Behavior Scale

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Abstract

Systematic measurement of simultaneous disordered eating patterns and alcohol consumption enables practitioners to identify harmful behaviors and evaluate behavior change. Despite instruments existing which measure these behaviors, few are tested for gender/ethnicity invariance or against measures for disordered eating behaviors and harmful alcohol consumption, rendering limited empirical support for utility. The College Eating and Drinking Behaviors Scale (CEDBS) is a three-factor, self-report measure. The purpose of this study was to conduct a confirmatory factor analysis, invariance testing, and evaluation of predictive validity. Participants included 583 traditional college students from two Southern universities who reported past 30-day alcohol consumption. Results supported the three-factor structure, and evidence of predictive validity indicates that the CEDBS measures disordered eating and alcohol misuse behaviors within the context of food and alcohol disturbance. Findings suggested the CEDBS performs similarly across genders and some ethnicities.

Keywords College student hazardous drinking · College Eating and Drinking Behaviors Scale · Disordered eating behaviors · Psychometric evaluation

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Alcohol misuse and disordered eating are common behavioral problems on college campuses which represent a significant public health concern in the USA. Recent surveys found that approximately 33% of college students report occasional heavy episodic drinking (Schulenberg et al. 2018) and 13.5% of female and 3.5% of male college students screen positive for disordered eating behaviors (Eisenberg et al. 2011). Likewise, binge eating has been reported by nearly half (48%) of a college student sample (Kelly-Weeder 2011). Occurring in isolation, alcohol consumption and disordered eating behaviors are concerning because of many associated individual, societal, academic, and physical consequences (Heidelberg and Correia 2009; White and Hingson 2014). Of concern, increasing evidence suggests that alcohol misuse and disordered eating frequently co-occur among college students (Anderson et al. 2006; Benjamin and Wulfert 2005; Dunn et al. 2002; Giles et al. 2009; Wilkerson et al. 2017). For example, Burke et al. (2010) found that 14% of students reported restricting calories prior to drinking occasions to feel the effects of alcohol more quickly and to prevent weight gain. This phenomenon has been described as food and alcohol disturbance (FAD; Choquette et al. 2018), or inappropriate compensatory behaviors to avoid weight gain from consuming alcohol (Hunt and Forbush 2016; Lundholm 1989).

When examining group differences among these behaviors, female students are at higher risk for FAD as they are more likely to report skipping meals, using laxatives, and self-inducing vomiting (Kelly-Weeder 2011; Martin et al. 2015) while males may impulsively use more bulimic-type compensatory behaviors and experience more alcohol-related negative consequences (Wilsnack et al. 2018). Additionally, males report higher consumption of alcohol and have higher peak drinking occasions than females (Ward et al. 2015). Similarly, Whites typically report drinking more frequently than African Americans (Burke et al. 2010). Not only are the manners in which students restrict dietary intake and consume alcohol considerable risk factors for negative consequences, they also vary across sex and ethnicities.

Different assessment approaches have emerged to evaluate co-occurring alcohol misuse and disordered eating behaviors, which limits cross-comparisons of studies. One measure, the Compensatory Eating and Behaviors in Response to Alcohol Consumption Scale (CEBRACS; Peralta 2002), includes four subscales (alcohol effects, bulimia, dieting and exercise, and restriction) with evidence of acceptable internal consistency and no sex differences (Bryant et al. 2012) but focuses heavily on eating behaviors rather than simultaneous alcohol use and eating. More recently, Ward et al. (2015) found the Drunkorexia Motives and Drunkorexia Behaviors scales positively correlated with the Drinking Motives Questionnaire (DMQ; Cooper 1994), Eating Attitudes Test-26 (EAT-26; Garner and Garfinkel 1979), and Rutgers Alcohol Problem Index (RAPI; White and Labouvie 1989). This provided evidence of validity for the Drunkorexia scales related to motivations to perform behaviors in White, female college students. While these scales have evaluated eating and drinking behaviors representative of FAD, focus on motivations to engage in certain behaviors differs, and there are no clear indications about measurement invariance related to sex, race, or other demographic factors despite group differences that exist for these behaviors. Thus, a next step in the assessment of FAD may benefit from address some of these factors.

The purpose of this study was to confirm the factor structure of a different measure—the College Eating and Drinking Behaviors Scale (CEDBS; Landry et al. 2017). The CEDBS is a self-report instrument that assesses eating behaviors related specifically to alcohol misuse and negative consequences with three-factors demonstrating high internal consistency (i.e., quicker intoxication, offset calories, alternative methods). However, because the measurement of FAD using the CEDBS is in its early stages, this study explored three specific issues related to the psychometric properties of the CEDBS. First, we sought to confirm the previously identified three-factor structure using confirmatory factor analysis. Second, we evaluated the degree to which the CEDBS performs similarly across Whites and African American males and female college students using invariance testing. Finally, we investigated predictive validity of the CEDBS and hypothesized that positive associations would emerge with measures of disordered eating, alcohol misuse, and alcohol-related negative consequences while a negative association would emerge with measures of protective behavioral strategies (PBS), which are safe drinking behaviors intended to reduce alcohol consumption and associated negative consequences.

Materials and Methods

Data were collected from two universities in the Southeastern United States. Participants included 583 traditional age (i.e., 18 to 25 years of age) college students (432 from school A and 151 from school B; M = 20.31, SD = 1.73). To be eligible, participants must have reported consuming alcohol at least once within the 30 days prior to completing the survey. Most participants identified as White (56%, $n = 326$) and female (79%, $n = 361$). Though not included in invariance analyses due to small sample sizes, other races/ethnicities reported were Asian American ($n = 9$, 1.8%), Latina/Latino ($n = 18$, 3.6%), multiracial ($n = 6$, 1.2%), and Native American ($n = 1$, .2%). Academic status varied with 33% ($n = 190$) freshman, 21% ($n = 122$) sophomore, 21% ($n = 125$) junior, and 25% ($n = 146$) senior participants. Participants were recruited through each university's psychology research participants system (SONA Systems) and received partial credit to satisfy a research requirement. After reading and electronically providing informed consent approved by both University Institutional Review Boards, participants completed an online survey using a secure survey system (Qualtrics). All participants first completed a demographic questionnaire followed by study measures administered in random order to minimize order effects.

Measures

Eating and Drinking Behaviors

Participants completed the 25-item CEDBS, which measures intentional disordered eating behaviors engaged in prior to or while consuming alcohol (Landry et al. 2017). Participants responded to items such as "not eat before drinking alcohol because it gives you the best buzz," "limit the calories you eat all day when you know you are going to drink alcohol that night," and "consume alcohol by inhalation or smoking (e.g., vaportini)" using a scale ranging from 0 (never) to 6 (always). Landry et al. (2017) found support for three subscales: quicker intoxication (11 items, score range 0–66), offset calories (10 items, score range 0–60), and alternative methods (4 items, score range 0–16). Total scores ranged from 0 to 142 with higher scores representing more disordered eating behaviors related to drinking alcohol. All subscales have been positively correlated with typical weekly drinking and alcohol-related negative consequences (Landry et al. 2017). Internal consistency of the subscales in this sample was good ranging from .91 to .94.

Hazardous Drinking

The 3-item consumption subscale of the US version of the Alcohol Use Disorders Identification Test (US-AUDIT-C; Babor et al. 2016) was used to assess hazardous drinking. Compared with the AUDIT-C, The US-AUDIT-C has different response options for the consumption subscale items ranging from 0 to 6, and item 3 was changed to "how often do you have 5 drinks (male) 4 drinks (female) or more on one occasion" to better reflect the US definition of binge drinking (Higgins-Biddle and Babor 2018). Total US-AUDIT-C scores range from 0 to 18 with higher scores representing more hazardous drinking. Evidence supports the ability of the US-AUDIT-C to identify at-risk college drinkers (Babor al. 2016; Madson et al. 2018). Internal consistency for the US-AUDIT-C was poor ($\alpha = .54$) with this sample (as compared with $\alpha = .66$ in a study by Choquette et al. 2018). For one of the university samples in this study, responses to one question was not consistent and suggests some confusion related to the item, as internal consistency would improve to $\alpha = .78$ for the total sample including both schools if that item was removed. As fewer items usually result in lower reliability and our aim was to validate the CEDBS against a measure of hazardous drinking such as the US-AUDIT-C, we chose not to remove the one inconsistent item.

Alcohol-Related Negative Consequences

The 23-item Rutgers Alcohol Problem Index (RAPI) was used to assess alcohol-related negative consequences (White and Labouvie 1989; White et al. 2005). Participants indicated the degree to which they experienced consequences such as "not able to do your homework or study for a test" and "neglected your responsibilities" on a scale ranging from 0 (never) to 4 (more than 10 times). Scores ranged from 0 to 92 with higher scores representing more negative experiences experienced. Internal consistency for the RAPI in the present sample was good ($\alpha = .93$).

Protective Behavioral Strategies

The 18-item Protective Behavioral Strategies Scale – revised (PBSS-r; Madson et al. 2013) was used to assess PBS use. Participants reported how often they engaged in various behaviors such as "avoiding shots" or "knowing where your drink is at all times" using a scale ranging from 1 (never) to 6 (always). The two subscales of the PBSS-r include controlling consumption (CC, 12 items, score range 12–72) and serious harm reduction (SHR, 6 items, score range 6–36). Higher scores on each subscale indicated more PBS use. There was good evidence of reliability for the subscales (CC $\alpha = 91$, SHR $\alpha = .88$).

Disordered Eating

The EAT-26 (Garner and Garfinkel 1979) measured disordered eating behavior. Participants responded to items such as "am terrified about being overweight," "avoid eating when I am hungry," and "find myself preoccupied with food" using a scale ranging from 1 (always) to 6 (never). The EAT-26 has three subscales: diet (13 items, score range from 13 to 78), bulimia and food preoccupation (BFP; 6 items, score range 6–36), and oral control (OC; 6 items, score range 6–36). Internal consistencies for each subscale were adequate (diet $\alpha = .94$, BFP $\alpha = .78$, OC $\alpha = .79$).

Data Analytic Plan

Based on results from Landry et al. (2017), a confirmatory factor analysis was conducted on the three-factor model of the CEDBS using MPlus 7 (Muthén and Muthén 1998-2017). Due to non-normality, the Satorra-Bentler chi-square (2010) estimator was used. In addition to theoretical considerations, comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square of approximation (RMSEA) were used to evaluate model fit. For CFI and TLI fit indices, values above .95 reflected good model fit (Lei and Wu 2007), and RMSEA values of .07 or below suggested reasonable fit (Steiger 2007). Satorra and Bentler (2010)-scaled chi-square difference test was used to test alternative models which were as follows: (1) correlating error terms of several pairs of indicator items and (2) a reduced model, removing some of the items. Following confirmatory factor analysis, invariance testing was conducted to evaluate item loadings on sex and ethnicity. Changes in CFI of .01 or greater (Cheung and Rensvold 2002) and changes in RMSEA of .015 or greater (Chen 2007) indicated a lack of measurement invariance.

Evidence of validity was evaluated by conducting two path analyses. The first used CEDBS subscales as predictors and the US-AUDIT-C (consumption subscale), RAPI, PBSS-SHR (serious harm reduction subscale), and PBSS-CC (controlled consumption subscale) as alcohol outcomes. The second used CEDBS subscales as predictors and EAT-Diet (dieting), EAT-BFP (bulimia and food preoccupation), and EAT-OC (oral control) as eating outcomes.

Results

Means for the CEDBS items ranged from 1.20 to 2.02, with items which in the Alternative Methods subscale have issues with normality. There were no significant differences in the CEDBS subscales between males and females or Non-Hispanic Whites and African Americans with the exception of Alternative Methods, where Non-Hispanic Whites (M = 4.5) scored significantly lower ($p = .001$) than African Americans (M = 5.3).

The highest percent missing for any given item was 0.9%, with 22 of the 25 items at 0.3% or less. Given the low percentage of missing values across items and lack of a discernable pattern, linear trend at point in the SPSS 23.0 (IBM 2015) was used to replace missing values. Table 1 presents correlations, means, standard deviation, skewness, and kurtosis for the study measures used in path analyses. Path analyses were conducted in the Mplus 8.3 (Muthén and Muthén 1998-2017) using MLM estimation.

Confirmatory Factor Analysis

The confirmatory factor analysis revealed a model with reasonable fit based on RMSEA, but less than adequate fit based on CFI and TLI, $\chi^2(272) = 892.17$, CFI = .88, TLI = .87, RMSEA = .063 (90 CI .058–.067). Standardized loadings were strong for all items (21 of 25 above .70), and modification indices showed five pairs of items that appeared highly correlated (i.e., items 1 and 2, 8 and 10, 12 and 14, 17 and 18, and 20 and 21). Upon review, 4 of 5 pairs (20 and 21 were excluded) of error terms were correlated based upon theoretical similarity.

Table 1 Correlations, means, standard deviations, skewness, and kurtosis for select measures ($n = 583$)

Scale	1	2	3	4	5	6	7	8	9	10
1. CEDBS-QI	-									
2. CEDBS-OC	.62**	-								
3. CEDBS-AM	.58**	.61**	-							
4. AUDIT-C	.16**	.15**	.08	-						
5. RAPI	.48**	.40**	.40**	.16**	-					
6. PBSS-SHR	− .27**	− .20**	− .22**	− .02	− .24**	-				
7. PBSS-CC	− .24**	− .11*	− .06	− .26**	− .24**	.55**	-			
8. EAT-D	.30**	.39**	.25**	.05	.25**	− .17**	− .11*	-		
9. EAT-BFP	.28**	.35**	.24**	.06	.25**	− .13*	− .12**	.72**	-	
10. EAT-OC	.29**	.28**	.31**	.01	.28**	− .23**	− .11*	.60**	.62**	
Mean	14.63	12.14	4.83	10.29	6.88	29.06	47.09	31.71	14.49	13.43
SD	6.88	6.80	2.43	4.40	10.17	7.05	14.60	15.17	6.58	6.10
Skewness	1.35	1.95	3.42	− .22	2.42	− 1.07	− .13	.49	.47	.95
Kurtosis	1.22	3.52	11.99	− .67	6.40	.65	− .52	− .44	− .08	.96

CEDBS College Eating and Drinking Behavior Scale, *QI*, quicker intoxication, *OC* offset calories, *AM* Alternative Methods; *AUDIT-C* Alcohol Use Disorders Identification Test, Consumption, *RAPI* Rutgers Alcohol Problem Index, *PBSS* Protective Behavioral Strategies Scale, *SHR* serious harm reduction, *CC* controlled consumption, *EAT* Eating Attitudes Test, *D* dieting, *BFP* bulimia and food preoccupation, *OC* oral control

* $p < .01$

** $p < .001$

The resulting model had better fit on all indices, $\chi^2(268) = 629.17$, CFI = .93, TLI = .92, RMSEA = .048 (90 CI .043–.053). The Satorra and Bentler (2010)-scaled chi-square difference test showed significant improvement in model fit, $\Delta\chi^2(4) = 64.45$, $p < .05$.

Correlating error terms of items is an easy way to improve model fit. In the interest of parsimony and before proceeding with subsequent analyses, a reduced model that removed one item from each pair was tested. By removing the items and demonstrating comparable model fit, the instrument is shorter while retaining validity. Thus, items most direct and containing fewest words from the four pairs were chosen (i.e., items 1, 10, 12, and 17). Fit indices for the reduced model were comparable with the revised model, $\chi^2(186) = 474.94$, CFI = .93, TLI = .92, RMSEA = .052 (90 CI .046–.057). As the reduced model was more parsimonious, it was retained. Standardized loadings and Cronbach alphas of the reduced model are in Table 2. Correlations ($p < .001$) between latent variables were .69 for Quicker Intoxication with Offset Calories, .65 for Quicker Intoxication with Alternative Methods, and .64 for Offset Calories with Alternative Methods. An alternative model with one latent variable was tested, and the Satorra and Bentler (2010)-scaled chi-square difference test showed a significant decline in model fit, $\Delta\chi^2(3) = 195.92$, $p < .05$. Another alternative model was tested combining the Offset Calories and Alternative Methods subscales due to their theoretical similarity. The Satorra and Bentler (2010)-scaled chi-square difference test showed a significant decline in model fit, $\Delta\chi^2(2) = 191.88$, $p < .05$. Results from both alternative models and chi-square difference tests provide support for the three latent variable (i.e., three subscale) model.

Invariance Testing

Invariance testing was conducted on both sex and race. For gender, the baseline model with freely estimated male and female parameters was $\chi^2(372) = 778.33$, CFI = .910, TLI = .898,

Table 2 Standardized loadings and Cronbach alphas for reduced model CEDBS items

Subscale/item	Standardized loading*	Cronbach alpha
Quicker intoxication		.91
1. Have a lighter meal prior to drinking alcohol because it makes you get drunk more quickly.	.610	
3. Feel disappointed with your buzz when you eat before drinking alcohol.	.725	
4. Not eat before drinking alcohol because you plan on eating food after you are done drinking.	.698	
5. Are so busy that you forget to eat a meal before drinking alcohol.	.590	
6. Not eat before drinking alcohol because it gives you the best buzz.	.866	
7. Not eat food before drinking alcohol because eating food before drinking makes you feel sick to your stomach.	.791	
9. Have more fun when you drink on an empty stomach.	.851	
10. Drink on an empty stomach to save money for alcohol.	.769	
11. Eat less than you typically do before drinking alcohol in order to fit in with your peers.	.777	
Offset calories		.93
12. Prefer to drink alcoholic beverages with fewer calories.	.528	
13. Limit the calories you eat all day when you know you are going to drink alcohol that night.	.804	
15. Keep track of how many calories you are consuming from alcohol.	.715	
16. Worry that if you eat normally on a day that you drink alcohol then you will exceed your daily allowance of calories.	.859	
17. Exercise more rigorously than normal before drinking alcohol.	.758	
19. Eat less than you typically do before drinking alcohol because you are worried that you will gain weight.	.906	
20. Restrict calories prior to drinking alcohol to help maintain your figure.	.922	
21. Intentionally restrict your caloric intake prior to going out drinking.	.915	
Alternative methods		.94
22. Use laxatives prior to drinking alcohol.	.845	
23. Purge (i.e., self-induced vomiting) prior to drinking alcohol.	.879	
24. Consume alcohol by inhalation or smoking (e.g., vaportini).	.922	
25. Consume alcohol using alternative methods to drinking alcohol such as alcohol suppositories.	.905	

CEBDS College Eating and Drinking Behaviors Scale

* All item loadings $p < .001$

RMSEA = .061 (90 CI .055–.067). A model with all loadings constrained to be equal was tested, and fit indices were $\chi^2(393) = 805.91$, CFI = .908, TLI = .902, RMSEA = .060 (90 CI .054–.066). Based on change in CFI of .01 (Cheung and Rensvold 2002) and change in RMSEA of .015 (Chen 2007) criteria, the model fit did not materially decline, and therefore, loadings between males and females were considered invariant as the constrained model was more parsimonious. A model with all loadings and intercepts constrained to be equal was tested, and fit indices were $\chi^2(414) = 843.03$, CFI = .905, TLI = .903, RMSEA = .060 (90 CI .054–.065). Based on change in CFI of .01 and change in RMSEA of .015 criteria, the model fit did not materially decline, and therefore, loadings and intercepts between males and females were considered invariant as the constrained model was more parsimonious.

For race, the baseline model with freely estimated Whites and African Americans parameters was $\chi^2(372) = 733.01$, CFI = .913, TLI = .902, RMSEA = .060 (90 CI .053–.066). A model with all loadings constrained to be equal was tested, and fit indices were $\chi^2(393) = 777.62$, CFI = .908, TLI = .901, RMSEA = .060 (90 CI .054–.066). Based on change in CFI of .01 (Cheung and Rensvold 2002) and change in RMSEA of .015 (Chen 2007) criteria, the model fit did not materially decline, and therefore, loadings between Whites and African Americans were considered invariant as the constrained model was more parsimonious. A model with all loadings and intercepts constrained to be equal was tested, and fit indices were $\chi^2(414) = 840.42$, CFI = .898, TLI = .896, RMSEA = .062 (90 CI .056–.068). Based on change in CFI of .01 (Cheung and Rensvold 2002) and change in RMSEA of .015 (Chen 2007) criteria, the model fit did not materially decline, and therefore, loadings and intercepts between Whites and African Americans were considered invariant as the constrained model was more parsimonious.

Predictive Validity

The first path analysis (see Fig. 1) used CEDBS subscales as predictors and hazardous drinking (US-AUDIT-C), alcohol-related negative consequences (RAPI), and serious harm reduction (PBSS-SHR) and controlled consumption alcohol (PBSS-CC) protective behavioral strategies as alcohol outcomes. CEDBS-QI was a significant positive predictor of hazardous drinking and alcohol-related negative consequences and a significant negative predictor of serious harm reduction PBS and controlled consumption PBS (see Table 3). CEDBS-OC was a significant positive predictor of alcohol-related negative consequences and approaching significant as a positive predictor of hazardous drinking. CEDBS-AM was a significant positive predictor of alcohol-related negative consequences and controlled consumption PBS and approaching significant as a negative predictor of serious harm reduction PBS.

The second path analysis used CEDBS scales as predictors and EAT-26 scales as eating outcomes (see Fig. 2). CEDBS-QI and CEDBS-OC were significant positive predictors of most EAT scales, except for CEDBS-QI approaching significant with EAT-Diet (see Table 4). CEDBS-AM was a significant positive predictor of EAT-BFP.

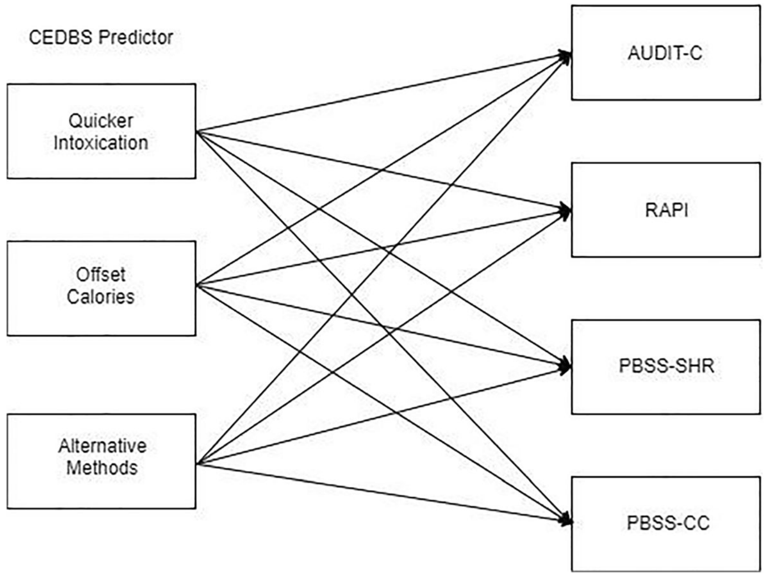

Fig. 1 Path Analysis Model of CEDBS Scales Predicting Alcohol Outcomes.

Table 3 Standardized loadings for the path model with alcohol outcomes

CEDBS Predictor	Outcome	Standardized loading	*p* value
Quicker intoxication	AUDIT-C	.131	.023
	RAPI	.335	< .001
	PBSS-SHR	− .211	< .001
	PBSS-CC	− .319	< .001
Offset calories	AUDIT-C	.108	.066
	RAPI	.105	.033
	PBSS-SHR	− .012	.833
	PBSS-CC	.026	.641
Alternative methods	AUDIT-C	− .058	.304
	RAPI	.143	.003
	PBSS-SHR	− .092	.082
	PBSS-CC	.107	.045

AUDIT-C, Alcohol Use Disorders Identification Test – Consumption Subscale; *RAPI*, Rutgers Alcohol Problem Index; *PBSS-SHR*, Protective Behavioral Strategies Scale – Serious Harm Reduction; *PBSS-CC*, Protective Behavioral Strategies Scale – Controlled Consumption

Discussion

We found support for the three-factor structure of CEDBS among multisite sample of college students. Additionally, a more parsimonious revised version of the CEDBS emerged such that in cases where pairs of items were highly correlated, we removed the wordier and less direct item. For example, "have a lighter meal prior to drinking alcohol because it makes you get drunk more quickly" and "eat less than you typically do before drinking because you believe you get drunk more quickly when you skip dinner" were highly correlated and we chose the first item. This resulted in a reduction of items from 25 to 21 without sacrificing information gleaned from the measure.

As expected, we found higher scores on the quicker intoxication subscale predicted increased hazardous drinking, more alcohol-related negative consequences, and reduced use of serious harm reduction and controlled consumption PBS. Similarly, higher scores on the

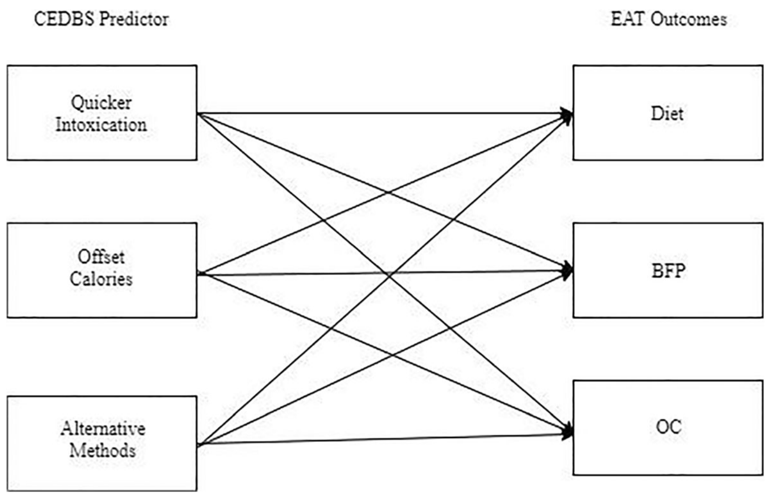

Fig. 2 Path analysis model of CEDBS scales predicting EAT outcomes

Table 4 Standardized loadings for the path model with EAT subscales

CEDBS predictor	EAT outcome	Standardized loading	*p* value
Quicker intoxication	Diet	.099	.055
	BFP	.111	.034
	OC	.115	.030
Offset calories	Diet	.348	< .001
	BFP	.285	< .001
	OC	.117	.031
Alternative methods	Diet	− .025	.631
	BFP	.170	.001
	OC	.002	.965

Note: Diet = Dieting Scale; BFP = Bulimia and Food Preoccupation Scale; EAT = Eating Attitudes Test; OC = Oral Control Scale.

offset calories and alternative methods subscales of CEDBS predicted increases in negative consequences while higher scores on alternative methods subscale predicted more use of controlled consumption PBS. Future research using the CEDBS should investigate its potential to identify problematic alcohol-related behaviors and target interventions to assess change over time in serious harm reduction and PBS use.

We also found that higher scores on quicker intoxication and offset calories predicted higher scores on every subscale of EAT and that higher scores on the alternate methods subscale predicted higher scores on the bulimia and food preoccupation. These findings suggest that these subscales are also assessing behaviors associated with disordered eating which is consistent with literature on co-occurring hazardous drinking and disordered eating behaviors among college students (Landry et al. 2015). Collectively, these results provide further evidence that the CEDBS can assess harmful eating and drinking behaviors among college students beyond focusing on a single construct.

This study uniquely found that the CEDBS performed consistently for men and women as well as for Non-Hispanic White and African American students. Similar to previous psychometric evaluations of similar measures (Bryant et al. 2012), our sample of males and African Americans was limited. However, we believe that the 120 males were enough participants to conduct invariance testing with reasonable certainty, as the ratio of subjects to variables is close to 20 to 1 (Stevens 2009). Despite this limitation, support for invariance of CEDBS increases confidence that group differences are more likely due to actual differences on the construct versus measurement error. Future studies should attempt to replicate our findings with larger, more diverse samples.

Our results suggest that the CEDBS has utility on college campuses. First, the measure could be part of intake procedures at university counseling centers to assess student risk of problematic eating and alcohol misuse behaviors. Similarly, the measure could be used as part of brief motivational interventions to help provide information about disordered eating and alcohol misuse behaviors. Specifically, students' results could facilitate a discussion about how they may incorporate safer drinking behaviors, including eating before or while drinking, that can help minimize the experience of alcohol-related negative consequences. Finally, alcohol and disordered eating researchers might use the CEDBS in studies investigating the combined effects of these problem behaviors on a variety of outcomes (e.g., academic success and retention, psychological distress, treatment outcomes).

Although there are several strengths to this study, such as the inclusion of two different size universities from different states, and a large sample size, there are limitations. For example, the sample consisted of mostly Whites and females, and thus, results could be affected given gender and racial variation in behaviors (Landry et al. 2015; Madson and Zeigler-Hill 2013). However, the sample was representative of both university populations and is reflective of previously reported samples (Barry and Piazza-Gardner 2012; Bryant et al. 2012; Eisenberg and Fitz 2014; Hunt and Forbush 2016). Despite this, recruiting equivalent groups is important. While the study included two universities from the same Southern region of the USA, results may not be generalizable to other regions. Including multiple geographically diverse universities would help address this limitation. In addition to addressing these limitations, future research should evaluate the CEDBS with at-risk college students for hazardous drinking such as members of Greek organizations and athletes.

Conclusions

Using more sophisticated evaluations of CEDBS, we found support for the three-factor structure previously reported as well as evidence of predictive validity related to alcohol outcomes and disordered eating behaviors. Finally, these findings suggest that the CEDBS has potential to be used consistently with men and women as well as Non-Hispanic Whites and African American US college students. Collectively, these results advance empirical support for the CEDBS for use in college student samples.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethics Statement This project received institutional review board approval and was conducted adhering to the American Psychological Association's research ethics guidelines which includes providing informed consent, ensuring confidentiality, and management of participant welfare.

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