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The Comprehensive Early Drinking History Form: A Novel Measure of Early Alcohol Exposure

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Abstract

Background: Adolescent and young adult alcohol use is a major public health concern; alcohol is the most widely used substance by teenagers (Johnston et al., 2015). It is imperative to better understand alcohol use during adolescence and early adulthood given the important changes that occur. Although numerous measures aim to capture alcohol use during this time, no existing measure gathers comprehensive information on alcohol use across these developmental stages. We developed the Comprehensive Early Drinking History Form (CEDHF), which retrospectively gathers drinking information for each year since onset of first regular use, including quantity/frequency of both regular use and periods of heaviest drinking. The CEDHF also collects information on aggregate drinking experiences between age of onset and age of first regular use.

Method: Using a sample of young adults (ages 21–27) from an ongoing longitudinal study, we examined whether the CEDHF predicted both concurrent ($N = 303$) and future ($N = 75$) alcohol-related problems over and above other commonly used alcohol use measures (e.g., age of onset, age of first intoxication, Timeline Follow-Back) and current alcohol problems.

Results: Controlling for gender, age, and current problems, the CEDHF predicted both concurrent and future alcohol-related problems over and above these other widely used measures of alcohol exposure.

Conclusions: The CEDHF may be a valuable tool when longitudinal studies are not feasible as it provides more comprehensive information than other widely used measures of early alcohol exposure. Further, this measure can provide detailed information regarding who is at highest risk for future consequences.

Keywords

Adolescence; Comprehensive; Drinking History; Psychometric; Alcohol Exposure

Introduction

Adolescent and young adult alcohol use is a major public health concern, as alcohol is the most widely used substance by teenagers and young adults (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2015). This is particularly alarming given that the brain is developing rapidly during these developmental periods, going through changes such as neurological and synaptic growth and pruning (Dosenbach et al., 2010; Gogtay et al., 2004; Spear, 2000). Prior research has shown that these changes in brain development continue into young adulthood; approximately through ages 25 to 30 (Dosenbach et al., 2010; Pujol, Vendrell, Junqué, Martí-Vilalta, & Capdevila, 1993). This brain development allows for engagement in more complex reasoning, including higher order executive functioning (Gogtay et al., 2004). Moreover, because these time-periods are marked by increased autonomy from parents and increased influence from peers and romantic partners, decision-making becomes increasingly important. Further, because reward and control systems develop at different rates, adolescents and young adults are more sensitive to the rewarding aspects of dangerous behavior (Casey, Jones, & Hare, 2008; Somerville, Jones, & Casey, 2010; Steinberg et al., 2008), placing them at increased risk for engaging in hazardous levels of alcohol use (Bava & Tapert, 2010; Clark, Thatcher, & Tapert, 2008; Schulenberg & Maggs, 2002).

Compared to older adults, adolescents and young adults who drink are also more susceptible to alcohol-related consequences and a variety of negative outcomes including impaired development, use of other substances, poor academic performance, greater interpersonal conflict, and future alcohol use (Bonomo et al., 2001; Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003; Miller et al., 2016; Spear, 2000; Wells, Graham, Speechly, & Koval, 2005; White and Labouvie, 1989). In light of these adverse consequences, it is imperative to gather information on drinking patterns across adolescence and young adulthood in an efficient and valid manner to better inform prevention and intervention efforts.

Researchers have used a variety of measures and strategies to capture alcohol use. Frequency and quantity measures date back to Straus and Bacon (1953). The basic premise of quantity/frequency measures is to take the average number of standard drinks per drinking occasion as a measure of quantity, and number of drinking occasions during a certain time-period as an index of drinking frequency. Examples of commonly used measures that capture drinking frequency and quantity include The Daily Drinking Questionnaire (DDQ), the Alcohol Use Disorder Identification Test (AUDIT), and the Timeline Follow Back (TLFB) interview (Collins, Parks, & Marlatt, 1985; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993; Sobell & Sobell, 1992).

Both the DDQ and AUDIT ask participants to aggregate across drinking episodes. However, the TLFB gathers information about alcohol use by having participants fill out a calendar of

their drinking behavior in the last month (or other specified time period). On each drinking day, they are to report the number of standard drinks they consumed. The TLFB has become one of the most widely used measures of alcohol use in recent years given high correlations with real-time self-report measures of alcohol consumption, and availability of more detailed information about individual drinking episodes relative to other quantity/frequency measures (Bernhardt et al., 2009; Carney, Tennen, Affleck, Del Boca, & Kranzler, 1998; Maisto, Conigliaro, Gordon, McGinnis, & Justice, 2008; Searles, Helzer, & Walter, 2000).

Though all of these measures provide important information about alcohol use over a specified time frame, none is able to provide a comprehensive understanding of alcohol use across an extended period of time. Getting a more complete picture of alcohol use over extended time periods is essential in understanding how early alcohol use impacts development, including development of Alcohol Use Disorders (AUDs). To our knowledge, there are only 2 comprehensive drinking history measures. The first is the Lifetime Drinking History (LDH; Skinner & Sheu, 1982). The LDH measures phases of drinking across the lifespan and collects information on quantity/frequency of alcohol use, type of alcohol, style of drinking, life events, and context of drinking within each phase. The LDH focuses on different phases or patterns of drinking (e.g. college drinking may be one phase with decreased alcohol use after graduation representing the start of a new phase). These phases can take place over variable time periods across individuals, resulting in considerable heterogeneity in drinking history profiles.

The LDH was adapted by Russell et al. (1997) to form the Cognitive Lifetime Drinking History measure (CLDH). The CLDH differs from the LDH by utilizing recall enhancement techniques, similar to those used in the TLFB, to help participants remember their drinking. Both the LDH and CLDH have high test-retest reliability and have been shown to be valid instruments for measuring lifetime drinking (Jacob, Seilhamer, Bargeil, & Howell, 2006; Russell et al., 1998). The validity of these instruments provide support for the idea that people can reliably report on drinking behaviors across long periods of time. Although the LDH and CLDH represent significant innovations in the assessment of comprehensive drinking histories, they may be most appropriate for older adults who have been through many decades of life and/or phases of drinking. In adolescence and young adulthood when drinking patterns are less stable and may show large fluctuations during important transitions (e.g., high school to college), a more fine-grained analysis of early drinking histories may be necessary (Stice, Myers, & Brown, 1998). Thus, the goal of the current study was to develop a measure that provides better resolution for capturing early drinking histories from age of onset through early adulthood. To accomplish this goal, this new measure gathers yearly reports of alcohol use from the time that regular drinking begins, as opposed to averaging across a period of several years. It also captures fluctuations in drinking patterns within a given year by gathering data on periods of both typical and heavier drinking. Finally, it captures the period between first drink and onset of regular drinking to provide comprehensive coverage from age of onset through early adulthood. To our knowledge, there has been little effort to develop similar comprehensive measures of early drinking history. Rather, measures of early alcohol use tend to focus on age of onset or recent drinking (e.g., past 3 months, past year).

Although existing measures of adolescent alcohol exposure have limitations, they provide strong evidence for the impact of early exposure on later outcomes. Age of onset of alcohol use is one of the most common measures of adolescent alcohol use, and research has consistently shown that an earlier age of first drink is associated with greater risk for alcohol use and problems. For example, Liang and Chikritzhs (2015) found that individuals who had their first drink before the age of 18 had significantly higher levels of heavy drinking than those who started drinking after the age of 21, even when controlling for other known confounders. Earlier age of onset is also predictive of later AUDs. In a longitudinal study, DeWit, Adlaf, Offord, and Ogborne (2000) showed that, after 10 years, about 14% of subjects who began drinking between the ages of 11 and 14 met criteria for alcohol abuse, and 16% met criteria for alcohol dependence. In contrast, rates of abuse and dependence for individuals who started drinking after age 19 were 2.0% and 1.0% respectively.

Although there is considerable support for age of drinking onset as a risk factor, results of other longitudinal studies investigating the strength and/or duration of these relations have been inconsistent. For example, several studies have demonstrated that age of onset is a weak predictor of later alcohol outcomes (Muthen & Muthen, 2000; Poikolainen, Tuulio-Henriksson, Aalto-Setälä, Marttunen, & Lönnqvist, 2001; Warner & White, 2003). Further, research has shown that these associations become weaker over time and that relations between age of onset and later drinking outcomes are more complex than originally thought (Afitska, Plant, Weir, Miller, & Plant, 2008; Labouvie, Bates, & Pandina, 1997; Maimaris & McCambridge, 2014). For example, recent studies suggest that feeling intoxicated at first use is predictive of later drinking outcomes over and above age of onset (Warner & White, 2003; Warner, White, & Johnson, 2007). Further, Morean, Corbin, and Fromme (2012) found that a shorter delay from first use to first intoxication was uniquely predictive of later heavy drinking and problems. Taken together, these studies suggest that relations between early use and later drinking outcomes are complex and that more information than age of first use is needed to understand risk for negative drinking outcomes.

Studies of drinking trajectories in adolescence also highlight the potential value of more comprehensive measures of early drinking history. Numerous trajectory studies have demonstrated diverse drinking patterns during adolescence and into young adulthood and these patterns relate differentially to risk for alcohol-related consequences (Colder, Campbell, Ruel, Richardson, & Flay, 2002; Danielsson et al., 2010; Shamblen, Ringwalt, Clark, & Hanley, 2014; Stice, Myers, & Brown, 1998). Unfortunately, current measures of retrospective drinking history either aggregate drinking experiences across long periods of time or gather detailed information across short periods of time. Therefore, these differences in drinking patterns across adolescence and young adulthood are lost in existing retrospective measures of adolescent drinking history. Thus, it is crucial to develop a measure that retrospectively gathers information on individual differences in patterns of drinking across adolescence and early adulthood.

Understanding the earliest drinking experiences (i.e., during adolescence) is critically important, but early adulthood is also a crucial period of risk that is characterized by considerable heterogeneity in drinking patterns (Auerbach & Collins, 2006; Brodbeck, Bachman, Croudace, & Brown, 2012). Although levels of alcohol use tend to peak in the

early to mid-twenties and then decline with age, a phenomenon known as “maturing out” (Jochman & Fromme, 2010), a substantial minority of young adults fail to mature out of heavy drinking patterns and ultimately experience significant problems later in life (Jackson, Sher, Gotham, & Wood, 2001). Thus, the transition to adulthood represents a high-risk period for negative alcohol consequences including AUDs.

The current study seeks to address the need for a validated retrospective measure of adolescent and young adult alcohol exposure that provides a comprehensive picture of drinking patterns during these critical developmental periods. The Comprehensive Early Drinking History Form (CEDHF) gathers information on age of onset, first intoxication, and first regular use. Additionally, it collects detailed information on drinking at each age since the onset of first regular use, including quantity and frequency of both regular use and periods of heaviest drinking. Finally, the CEDHF collects information on aggregate drinking experiences between age of onset and age of first regular use. To our knowledge, this is the first retrospective measure of early alcohol use that provides such detailed information about drinking history during this time-period. The CEDHF has the potential to provide more accurate and less heuristic based data than measures currently being used in the literature, and may ultimately provide a time- and cost-effective method of determining who is at greatest risk for later alcohol-related problems. To establish concurrent validity of this new measure, we examine concurrent relations between the CEDHF and other measures of alcohol use and related problems. We also examine the extent to which alcohol exposure assessed by the CEDHF shows incremental validity in the prediction of both concurrent and future alcohol-related problems over and above other common measures of alcohol use including the TLFB and early indicators of alcohol use assessed by the CEDHF (e.g. age of onset and age of first intoxication). Finally, we determine whether mode of administration of the CEDHF (online or over the phone) significantly impacts the results.

Materials and Methods

Measurement development

The CEDHF was designed to incorporate questions about age of onset and age of first intoxication, in addition to yearly reports of drinking behavior from the time of first regular use. To capture variability in drinking within each time-period, the CEDHF also includes questions about both typical and heavy drinking within each year. Finally, to fully capture use from the time of drinking onset, the CEDHF assesses drinking that occurred between age of first use and age of first regular use.

Participants

Development of the CEDHF took place in the context of an ongoing alcohol challenge study investigating the effects of social and physical context on subjective responses to alcohol. The longitudinal parent study includes 2 in-person sessions and 4 follow-up online/phone-interview sessions that take place across a two-year timespan. The study has full Institutional Review Board approval from the university in which it is being conducted. Eligibility criteria include binge drinking (5 or more drinks in one sitting for men/4 or more for women) at least once a month over the last year. Individuals were excluded from the study if they

reported current clinical levels of anxiety or depression, met criteria for Alcohol Dependence (past month), had ever participated in abstinence-oriented treatment programs, or were pregnant (for women). Additionally, individuals who reported negative side effects of consuming alcohol were excluded to protect against undue discomfort. Recruitment consisted of flyers placed around campus and the surrounding community as well as online advertisements.

Procedure

Participants first came into the lab for a series of surveys and interviews to determine eligibility. The online version of the CEDHF was administered during this session to a total of 114 participants. If they met inclusion criteria, participants returned to the lab within a few weeks to complete the alcohol administration session. Following the alcohol administration session, participants completed online/phone interviews and web-based survey assessments every 6 months for a total of 2 years (4 follow-ups in all). Participants were compensated \$12 an hour for the time spent in the lab and \$30-\$40 per follow-up with a \$20 bonus for completing all four follow-ups. Because the current study took place in the context of an ongoing study, some participants had already gone through the two in-person sessions when the CEDHF was introduced. For these individuals, we administered the CEDHF at either the 12-month or 24-month (if they had already completed the 12-month) follow-up. In all, 114 participants completed the CEDHF at session 1, 113 completed it at the 12-month follow-up, and 82 completed it at the 24-month follow-up. Two participants who took the CEDHF at both the 12 and 24-month follow-up (the only participants, at the time, who were in the study long enough to take it at two timepoints), and 2 who reported no drinking on the CEDHF at session 1 were excluded from analyses. This resulted in 112 participants who completed the CEDHF at session 1 only, 111 at the 12-month follow-up only, and 80 at the 24-month follow-up only. We combined these samples into an aggregate total sample of 303 for analyses.

Measures

Demographics.—Demographic variables included age, sex, race/ethnicity, marital status, self-reported most recent semester GPA, and socioeconomic status.

Comprehensive Early Drinking History Form (CEDHF).—The CEDHF was initially developed from questions that are widely used in the literature to gather information about age of onset and age of first intoxication. The remainder of the measure contains quantity/frequency questions similar to the approaches described in the introduction (e.g., DDQ). The CEDHF includes questions about drinking behavior for each year starting with the onset of regular drinking (drinking at least once a month). For example, the CEDHF provides the definition of a standard drink and then asks, “When you were (age of first regular use) how often did you typically consume alcohol (i.e., beer, wine, wine cooler, or liquor)?” and, “When you drank at (age of first regular use), about how many standard drinks (cans of beer, glasses of wine, bottles of wine coolers, or drinks of liquor) did you typically have in one day?” Responses ranged from *never* to *everyday* for frequency (8 total options) and *0 drinks* to *10 or more drinks* for quantity (6 total options). We then converted these questions into continuous variables by giving a count score for each question. For example, for the

frequency question, if they responded with 1–3 times a month we gave them a score of 24 and if they responded with 5–6 drinks for the quantity question we gave them a value of 5.5. These questions were repeated for each age up until the current age. Similar language was used to assess heaviest period of drinking each year. The CEDHF asks “Sometimes people have periods of time when they drink more heavily than is usual for them. Did you ever have a significant period of weeks or months at (age of first regular use) when you drank more heavily than is usual for you?” If an individual responded “yes,” they were asked to indicate how long this heavier period of drinking lasted, with response options ranging from “less than one week” to “ten or more months.” They were then asked the same two questions about frequency and quantity of alcohol consumption during this heavier period of drinking. In addition to assessing typical and heavy drinking experiences from participants’ age of first regular use (drank at least once a month) to their current age, the CEDHF includes two questions (one about total number of drinking experiences and one on average number of drinks consumed) aggregating drinking experiences from age of onset to age at which an individual first started drinking regularly. This allows for the creation of an index of total lifetime exposure (total lifetime number of alcoholic drinks consumed).

Given concerns regarding the accuracy of human memory, we made every effort to minimize the impact of memory problems. For example, questions regarding periods of heaviest drinking served as a cue for heterogeneity in drinking patterns within a year, and participants were reminded of previous answers to aid their memory. In the current study, the CEDHF typically took 10–15 minutes to administer. See Appendix A for the complete measure with all instructions, items, and responses.

Timeline Follow-Back Interview (TLFB).—The 30-day TLFB was collected at all time-points (Sobell & Sobell, 1992). Participants filled out a calendar of their drinking behavior over the past month including how many drinks they had on each occasion and the time over which they drank them. To enhance memory recall, participants were given a drink conversion chart, told to think about important events that happened within the past 30 days, and were allowed to check their personal calendars (including phone calendars). As stated above, previous studies have shown the TLFB to be a reliable and valid retrospective measure of alcohol use.

Young Adult Alcohol Consequences Questionnaire (YAACQ).—The YAACQ is a 48-item measure that assesses eight categories of consequences resulting from alcohol use in the past 30-days and was administered at all time-points (Read, Kahler, Strong, & Colder, 2006). Sample items include, “I have passed out from drinking,” and “I have neglected my obligations to family, work, or school because of drinking.” Responses are in a dichotomous yes/no format. Original scale development indicated that each of the eight subscales of YAACQ has internal consistency reliabilities of .70 or greater. The current study relied on the total score and internal consistency reliabilities in the current sample ranged from .89 to .96 at all timepoints.

Data Analytic Plan

Prior to conducting the primary analyses, variables that were non-normally distributed were log-transformed. Additionally, outliers that had the potential to impact the results were removed or windsorized (replaced with the highest valid value in the distribution) depending upon the nature of the out of range values.

Because two separate methods were used to administer the CEDHF (e.g. online at session 1 and phone interview at the 12 and 24-month follow-ups), ANOVA was used to compare means for the two versions while using the TLFB and current age as covariates to control for differences in recent drinking between groups. We hypothesized that there would not be significant mean differences between the versions/time-points.

To evaluate the concurrent and incremental validity of the CEDHF, correlation and regression analyses examined relations between indices of drinking from the CEDHF and other established measures of alcohol use and problems. A total of 4 drinking indices (2 for yearly average and 2 for lifetime total volume) were calculated from the CEDHF. *Total lifetime volume* was calculated by summing the total number of drinks for each year since the onset of regular use and the total amount consumed from onset of first drink to onset of first regular use. *Yearly average* used only information since the age of first regular use and divided the sum of drinking across all years by the number of years since the age of first regular use. We chose not to include drinking between age of first use and age of first regular use in the yearly average score as a prolonged period of non-regular drinking would result in a yearly average that is not reflective of the individual's typical levels of alcohol use. For both total volume and yearly average, scores were calculated with only typical drinking, and with the addition of periods of heavy drinking, to examine the added value of the latter information.

To determine if inclusion of heavy drinking questions captured important information not captured by assessment of typical drinking behavior, we evaluated whether accounting for fluctuations in drinking patterns within each year impacted the results. This was done by testing for differences in the magnitude of correlations between the TLFB and indices from the CEDHF that did and did not include heavy drinking using the procedures outlined by Steiger (1980). The Steiger method is an adaptation of Hotelling's t-test of correlated correlations, where the correlation coefficients are converted into z-scores to account for nonnormality of the distributions of correlations.

Next, analyses examined relations between the two primary CEDHF indices (total lifetime volume and yearly average) and both the TLFB and YAACQ. It was hypothesized that the TLFB would correlate more strongly with the yearly average index relative to the index that also included drinking from age of first use to age of first regular drinking (total lifetime volume), given the more sporadic and distal nature of drinking behavior prior to the age of first regular use. In contrast, we hypothesized that the total volume index which includes the early drinking period would be more highly correlated with alcohol-related problems (YAACQ) given the established importance of early onset of use in the development of alcohol problems.

Next, we assessed the incremental validity of the CEDHF in predicting alcohol-related problems (YAACQ), above and beyond the effects of age, gender, age of first use, age of first intoxication, and the TLFB (total drinks in the past 30 days). Because the predictor variables in these analyses were expected to be substantially correlated, tolerance and variance inflation factor (VIF) scores were examined to ensure that there were not significant problems with multicollinearity. VIF values below ten and tolerance values above .10 were considered as evidence for a lack of problems related to multicollinearity (Tabachnick & Fidell, 2007).

Cross-sectional analyses utilizing the full sample examined whether the CEDHF indices predicted concurrent alcohol-related problems (YAACQ) over and above age, gender, age of first use, age of first intoxication, and the TLFB. Covariates of gender and age were entered in Block 1, followed by age of onset, age of first intoxication, TLFB and the CEDHF in subsequent Blocks. With regard to the longitudinal regression analyses, a subsample of 75 participants who completed the CEDHF at the 12-month follow-up and had data from the YAACQ at both the 12 and 18-month follow-ups were included. CEDHF scores at the 12-month follow-up were used to predict future alcohol-related problems (YAACQ at the 18-month follow-up) over and above age, gender, age of onset, age of first intoxication, current drinking (TLFB at the 12-month follow-up), and current alcohol-related problems (YAACQ at 12-month follow-up). In both the cross-sectional and longitudinal analyses, the CEDHF indices were expected to significantly predict alcohol-related problems over and above the covariates of age and gender, and other established measures of alcohol use (and current alcohol problems in the longitudinal analyses).

Finally, we utilized latent growth modeling in Mplus to examine whether drinking trajectories captured by the CEDHF predicted concurrent drinking (TLFB) and alcohol-related problems (YAACQ) over and above other common measures of alcohol consumption. We focused exclusively on concurrent rather than prospective prediction, as the sample size for the longitudinal analyses ($n = 75$) was not sufficient for conducting growth models. We used bootstrapping with 5000 bootstraps to account for any non-normality in the data. The models included total drinks consumed per year, including periods of heavy drinking, from ages 16 to 25 to examine drinking intercepts (yearly consumption at age 16) and slopes (changes in yearly consumption from age 16 to age 25). This age range was selected given low endorsement of alcohol use prior to age 16 and the low number of participants with data beyond the age of 25. This age range extends from adolescence into early adulthood, representing peak developmental periods for heavy drinking and alcohol-related problems.

We began by fitting unconditional growth models to determine the shape of the growth curves (linear vs. quadratic) and determine if there was significant individual variability in intercepts and slopes. Next, we examined intercepts and slopes from the CEDHF as predictors of alcohol use (TLFB) and problems (YAACQ) at the time point when the CEDHF was administered. To reduce complexity, given the sample size for these computationally demanding analyses, we included age, gender, age of first use, age of first intoxication, and TLFB scores (for the problems model) only if they significantly predicted the outcome prior to entering the CEDHF indices. We anticipated that both the intercepts

and slopes would significantly predict both concurrent alcohol use and problems. However, we expected larger effects for slopes given that age of onset and age of first intoxication were expected to account for substantial variance in the intercepts (drinking and alcohol problems at age 16).

Results

Preliminary Analyses

When examining the distributions, the CEDHF indices were positively skewed due to outliers on the high-end of the distribution. The TLFB and YAACQ distributions were also positively skewed though there were not clear outliers. Therefore, we winsorized the outliers (less than 2% of cases for each index) in the CEDHF distributions, and log-transformed the TLFB and YAACQ distributions. Winsorizing and log transforming resulted in relatively normal distributions (skewness values were all less than 2). Means, standard deviations, and ranges of all variables of interest are included in Table 1.

Mode of Administration/Time-point

Using ANOVA and controlling for participant's current age and current drinking, we sought to determine if mode of administration/time-point (e.g. online at session 1 and phone interview at 12 and 24-month follow-ups) impacted the results. Results showed that, controlling for effects of age and concurrent TLFB scores, mode of administration/time-point was not significantly associated with either the two total volume indices or the two yearly average indices (Total volume: *Wilks' λ* = .980, *F*(4, 586) = 1.521, *p* = .194; Yearly Average: *Wilks' λ* = .980, *F*(4, 588) = 1.505, *p* = .199). Consistent with expectations, drinking was non-significantly greater at the 12 and 24-month follow-ups (relative to session 1), as participants were 1 and 2 years older at these time-points, respectively. Given the lack of significant differences by mode of administration, subsequent analyses collapsed across mode of administration/time-point. Means for each of the four CEDHF indices at each time-point, not controlling for age or current drinking, are depicted in Figures 1 and 2.

CEDHF Indices

Next, we used the Steiger method (1980) to examine whether including periods of heavy drinking in the calculation of CEDHF scores impacted correlations with the TLFB. Results showed that there were no significant differences in correlations between the TLFB and indices that did and did not include heavy drinking (lifetime total volume *z-score* = .969, *p* = .33; yearly average *z-score* = .113, *p* = .91). Although relations with TLFB drinking did not vary by inclusion/exclusion of heavy drinking periods, we chose to use the indices that included heavy drinking in subsequent analyses to take advantage of the more comprehensive information provided by these measures.

Next, we examined whether total lifetime volume and yearly average indices were differentially related to TLFB and YAACQ scores. Results showed that the magnitude of correlations did not differ for either the TLFB or the YAACQ (TLFB: *z-score* = 1.236, *p* = .217; YAACQ: *z-score* = .613, *p* = .540). Despite the lack of significant differences in this analysis, given the important conceptual difference between total lifetime volume and yearly

average, incremental validity analyses continued to examine these two indices as separate predictors. Correlations among the two CEDHF indices and the outcome measures at all time-points, which speak to the convergent validity of the measure, are presented in Table 3.

Incremental Validity

CEDHF indices were first used to predict concurrent alcohol-related problems over and above other common measures of alcohol use. Given significant correlations between age of first use and age of first intoxication, we examined variance inflation factors (VIF) and tolerance values to ensure that there were not significant problems with multicollinearity (e.g., VIF > 10 or tolerance values < .10). All VIFs were less than 5 and all tolerance values were greater than .20 indicating there were not significant problems with multicollinearity. Both the lifetime total volume and yearly average indices accounted for unique variance in alcohol problems over and above age, gender, age of first use, age of first intoxication, and past 30-day drinking from the TLFB (lifetime total volume: $\beta = .20$, $p = .003$; yearly average: $\beta = .18$, $p = .013$).

Next, analyses were conducted to determine if CEDHF indices accounted for unique variance in future problems over and above age, gender, and other common measures of concurrent drinking and baseline alcohol problems. Results showed a similar pattern to the cross-sectional analyses. Both CEDHF indices at the 12-month follow-up were significant predictors of alcohol-related problems 6-months later accounting for effects of age, gender, age of onset, age of first intoxication, concurrent TLFB, and alcohol problems at the 12-month follow-up (lifetime total volume: $\beta = .24$, $p = .042$; yearly average: $\beta = .21$, $p = .048$). Standardized regression coefficients and model summary information are included in Tables 4 and 5.

Growth Model Analyses

Results of unconditional growth models indicated better fit for a quadratic, relative to a linear model, and there was significant variance in the intercept and linear slope, and marginally significant variance in the quadratic slope (intercept: $\sigma^2 = 4.498$, $p = .008$; linear slope: $\sigma^2 = .388$, $p = .014$; quadratic slope: $\sigma^2 = .003$, $p = .062$).

Next, we examined intercepts and slopes from the CEDHF as predictors of concurrent alcohol use and problems. Additional predictors in the alcohol use model included current age ($\beta = -.034$, $p = .034$), gender ($\beta = -.137$, $p = .013$), age of first intoxication ($\beta = -.062$, $p = .014$), and age of onset ($\beta = .006$, $p = .795$). Accounting for effects of these other significant predictors, the slope, but not the intercept, from the CEDHF significantly predicted concurrent alcohol use from the TLFB (intercept: $\beta = .080$, $p = .119$; slope: $\beta = .603$, $p = .001$). With regard to the YAACQ model, current age and TLFB were the only significant predictors (current age: $\beta = -.030$, $p = .043$; TLFB: $\beta = .384$, $p < .001$) included in the model along with the intercept and slope from the CEDHF. While the pattern of results was similar to the analyses for YAACQ scores, the slope was only a marginal predictor ($\beta = .253$, $p = .085$). Again, the intercept was not a significant predictor ($\beta = .035$, $p = .297$).

Discussion

The current study aimed to develop and validate a novel retrospective measure of adolescent alcohol exposure, the CEDHF. This measure incorporates questions about participants' age of first use, age of first intoxication, and the age at which they started to drink regularly (any drinking at least once a month), along with detailed quantity and frequency information on their typical and heavy drinking periods each year from the time they started drinking regularly. The CEDHF also collects information about aggregate drinking experiences from age of first use to the age at which an individual starts regularly drinking. These data provide two primary indices from the CEDHF (total lifetime volume of alcohol use, and yearly average use since onset of regular drinking). This is the first measure that gathers this type of detailed drinking information across this time-period and fills an important gap in the literature regarding the measurement of adolescent and young adult alcohol exposure. We sought to determine whether mode of administration and inclusion of periods of heavy drinking impacted the results, which CEDHF indices provided the most useful information, and the validity (concurrent, convergent, and incremental) of the measure.

With regard to the first aim, results did not differ depending on whether participants took the CEDHF online or over the phone, suggesting that future researchers can administer the CEDHF over the phone or online depending on their needs and resources. Analyses also failed to find differences in relations between CEDHF indices and past month drinking (TLFB) with the inclusion of heavy drinking periods in the calculation of total lifetime volume and yearly average drinking. Despite the lack of differences in these analyses, additional analyses included periods of heavy drinking to be as comprehensive as possible in assessing drinking history. There may also be utility in retaining information about heavy drinking periods in this measure as it serves to cue participants about potential variability in drinking habits within a particular year.

The CEDHF demonstrated strong evidence for convergent and concurrent validity, given large significant correlations of total lifetime volume and yearly average drinking with the TLFB (past 30-day drinking) and YAACQ (alcohol problems) scores. Additionally, we examined incremental validity both cross-sectionally and longitudinally. With respect to incremental validity, CEDHF indices predicted concurrent alcohol-related problems over and above the 30-day TLFB and indicators of early use within the CEDHF including age of onset and age of first intoxication. The CEDHF indices also prospectively predicted alcohol-related problems six months later, above and beyond the effects of other well-established measures of drinking behavior and prior alcohol-related problems. Therefore, the CEDHF demonstrates convergent, concurrent, and incremental validity.

Gathering yearly drinking information also provides the opportunity to model alcohol use trajectories from adolescence into young adulthood. While sufficient data were not available to prospectively predict later alcohol use, growth models based on CEDHF data identified significant individual variability in intercepts (age 16 drinking) and slopes (changes in drinking from age 16 to age 25). Further, slopes from these growth models accounted for significant variance in concurrent alcohol consumption and marginally significant variance in concurrent alcohol-related problems, accounting for effects of important covariates. These

results are important given that this is the first measure capable of retrospectively capturing these nuances in early drinking patterns. Moreover, these findings support the potential utility of more complex analyses of CEDHF data which could yield new insights regarding both the outcomes (e.g., alcohol-related problems, comorbid disorders like depression and anxiety) and causes (e.g., family history, adverse childhood environments) of distinct trajectories of alcohol use during this critical developmental period.

Collectively, results of our analyses suggest that the CEDHF captures unique information relative to other alcohol consumption measures. Currently, age of onset and age of first intoxication are the most widely used items to capture early alcohol exposure. The CEDHF was able to predict concurrent and future alcohol problems over and above these measures, suggesting that the CEDHF may be a valuable tool for getting a comprehensive understanding of adolescent and young adult alcohol use.

Although the magnitude of correlations with TLFB drinking and alcohol problems (YAACQ scores) was similar for CEDHF lifetime total volume and yearly average drinking, these two indices may have unique value in specific contexts. For example, lifetime total volume may be more useful in studies examining the impact of lifetime alcohol exposure on brain development or future consequences such as the National Consortium on Alcohol and Neurodevelopment in Adolescence (ncanda.org) and the Adolescent Brain Cognitive Development (addictionresearch.nih.gov) studies. In contrast, the yearly average index may be more appropriate for studies that need trajectory like information to understand individual differences in patterns of use over time. Future studies are needed to determine the contexts in which each of the CEDHF indices is most useful in capturing aspects of early alcohol exposure.

Although the current study fills an important gap in the literature by developing the first comprehensive measure of adolescent and young adult alcohol exposure, there are limitations that should be considered. First, the CEDHF asks participants to retrospectively report on their drinking behavior across many years. While numerous studies have shown that participants can reliably report on past drinking behavior (Burleson & Kaminer, 2006; Chu et al., 2010; Donahue et al., 2007; Hagman et al., 2010; Harris, Wilsnack, & Klassen, 1994; McGillicuddy & Eliseo-Arras, 2012), there are also studies that call the accuracy of retrospective self-report measures into question (Fendrich & Rosenbaum, 2003; Hoepfner, Stout, Jackson, & Barnett, 2010; Percy et al., 2005; Searles, Helzer, Rose, & Badger, 2002). However, the LDH has repeatedly been shown to have high reliability and gathers information across several decades (Jacob et al., 2006; Russell et al., 1998). This suggests that it is possible for individuals to reliably report on their drinking behaviors over long periods of time. It is important to note that the CEDHF asks participants to report on fewer behaviors than other measures like the LDH, which examines type of alcohol, style of drinking, and drinking context. While this is a limitation of the CEDHF relative the LDH, memory biases may be less problematic as the CEDHF assesses drinking across a much shorter time more proximal to age of onset. Nonetheless, future research is needed to compare CEDHF scores to prospective reports of drinking across adolescence and early adulthood to provide further evidence for its validity. Further, assessing the stability of CEDHF reports over time (e.g. completing the CEDHF at multiple time points) would speak

to the reliability of these reports. Regardless, data collected through the CEDHF is likely to provide more valid data than single item questions about age of first use or age of first intoxication.

Another potential limitation of the CEDHF is that response options for quantity ranged from zero to 10 or more drinks, which could result in underestimates of drinking if participants consistently consume well more than 10 drinks on average. We chose to cap the measure at 10 or more because we thought that people would be unlikely to report more than 10 drinks per drinking occasion and reporting the full range of drinking would result in a small number of cases on the high end which would create greater positive skew in the distributions. Although this approach could lead to underestimates of total alcohol exposure, this would likely attenuate relations between CEDHF scores and drinking outcomes rather than inflating them. Further, the response options for both quantity and frequency included ranges which make our data an estimate rather than an exact value. While having this range of data instead of exact values is a limitation, our response options are similar to those used in other well validated alcohol consumption measures (National Epidemiologic Survey on Alcohol-related Conditions III, 2016; Saunders et al., 1993).

Another limitation pertains to the characteristics of the current sample. As outlined previously, the CEDHF gathers much more detailed drinking information than previous measures of lifetime drinking history. Given that retrospective recall becomes more difficult with the passage of time, it is not clear if this measure will be appropriate for older populations (e.g., over 30). The CEDHF was developed to be administered to adolescents and young adults (approximately under the age of 30) given that these periods are characterized by elevated risk for AUDs (Auerbach & Collins, 2006; Brodbeck et al., 2012; Jackson et al., 2001). The current study was only able to include participants ages 21–27 as it was part of larger study. Thus, we do not know how this measure or the results of this study would hold up when using older or younger samples until research using the CEDHF in these populations is conducted.

Finally, this study excluded very light drinkers and those with a past month AUD diagnosis. While the lightest and heaviest drinkers were excluded from the study, resulting in a sample of moderate to heavy drinkers, our sample is similar to nationally representative samples with respect to mean levels of alcohol use (Grant, Stinson, & Hartford, 2001). Nonetheless, it is possible that the truncated range of drinking data may have impacted the findings, though it seems likely that this would result in weaker rather than stronger relations between the CEDHF and measures of current alcohol use and problems. Thus, the findings may represent a conservative estimate of relations between drinking history and current use and problems. Future studies using the full range of drinking behavior are needed to provide further information about the generalizability of our findings. Although the current sample has some limitations, it did include both college and non-college students suggesting that the results are likely to generalize beyond the college environment.

Despite the limitations noted above, the current study contributes to the literature by developing and assessing the psychometric properties of a comprehensive adolescent and young adult drinking history measure with the potential to improve our understanding of

both the causes and consequences of unique drinking trajectories across adolescence and early adulthood. As discussed previously, adolescence and young adulthood are critical time periods for understanding risk for AUD's (Auerbach & Collins, 2006; Brodbeck et al., 2012; Jackson et al., 2001). The results of this study suggest that the CEDHF could provide valuable information about who is at highest risk for alcohol-related consequences later in life. Previously the only way to gather this type of information would be in expensive and time-consuming longitudinal studies where researchers track participants for many years. Because the CEDHF is cost and time-efficient, it can be used to gather this type of information on a much larger scale. Although data from prospective longitudinal studies are clearly preferable, the CEDHF may represent a desirable alternative when researchers do not have the resources to conduct a longitudinal study across adolescence and early adulthood. Further, given that it collects data on lifetime drinking experiences, the CEDHF could be used in conjunction with neuroimaging and cognitive tasks to inform our understanding of critical developmental periods when the brain is most susceptible to the iatrogenic effects of alcohol consumption. This information about *when* adolescents and young adults are at highest risk for heavy alcohol use and related cognitive impairment, could also inform the timing of prevention and intervention efforts.

In summary, the current study supports the validity and utility of the CEDHF, a novel measure of adolescent and young adult alcohol exposure. To our knowledge, this is the first study to retrospectively assess alcohol exposure from adolescence through early adulthood at such a granular level, thereby addressing an important gap in the literature. The CEDHF has the potential to inform the timing of prevention and intervention efforts and provides unique information relative to widely used measures of early and recent alcohol exposure. Research using the CEDHF may ultimately provide important new insights regarding the impact of early drinking experiences. Future studies should compare the CEDHF to prospective reports of drinking and utilize this measure in a variety of populations (e.g., different age groups) to better understand the development and consequences of heavy alcohol use in adolescence and early adulthood. This could help inform who is at highest risk for later alcohol problems, including AUDs.

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Appendix

Comprehensive Early Drinking History Form

We will be gathering information about your drinking experiences at different ages each year from when you first began drinking regularly to the present. It may help to remember a significant event that happened that year to help you remember your drinking patterns. We will then go back and ask you about your earliest drinking experiences.

We are going to be asking you questions about your alcohol consumption in terms of “standard drinks.” One standard drink is equivalent to a 12 oz can of beer, 5 oz glass of wine, or a 1.5 oz shot of liquor or spirits.

1. How old are you?
2. How old were you when you first consumed at least one standard drink (full beer, glass of wine, or mixed drink)?
3. How old were you when you first drank enough alcohol to become intoxicated?
4. How old were you when you started to drink regularly (at least once a month)?

As a reminder, one standard drink is equivalent to a 12 oz can of beer, 5 oz glass of wine, or a 1.5 oz shot of liquor or spirits. It may help to remember a significant event that happened that year to help you remember your drinking patterns.

5. When you were (*age of first regular use*) how often did you **typically** consume alcohol (i.e. beer, wine, wine cooler, or liquor)?
 - Never
 - 1 to 2 times in that year
 - 3–5 times in that year
 - More than 5 times, but less than once a month
 - 1–3 times a month
 - 1–2 times a week
 - 3–5 times a week
 - Everyday
6. When you drank at (*age of first regular use*), about how many standard drinks (cans of beer, glasses of wine, bottles of wine coolers, or drinks of liquor) did you **typically** have in one day?
 - 0
 - 1 or 2
 - 3 or 4
 - 5 or 6
 - 7, 8, or 9
 - 10 or more
7. Sometimes people have periods of time when they drink more heavily than is usual for them. Did you ever have a **significant period of weeks or months** at (*age of first regular use*) when you drank more heavily than is usual for you? For example, did you have any extended periods of time when on average you drank

more than (*answer from #6*) drinks or consumed alcohol more frequently than (*answer from #5*)?

- Yes
- No

If Yes:

8. In the **period of your heaviest drinking** at (*age of first regular use*), how often did you consume alcohol (i.e. beer, wine, wine cooler, or liquor)?

- Never
- 1 to 2 times in that year
- 3–5 times in that year
- More than 5 times, but less than once a month
- 1–3 times a month
- 1–2 times a week
- 3–5 times a week
- Everyday

9. During your **period of heaviest drinking** at (*age of first regular use*) about how many standard drinks (cans of beer, glasses of wine, bottles of wine coolers, or drinks of liquor) did you typically have in one day?

- 0
- 1 or 2
- 3 or 4
- 5 or 6
- 7, 8, or 9
- 10 or more

10. When you were (*age of first regular use*), cumulatively how long did this **period of heavy drinking** last?

- Less than 1 week
- 1 week
- 2 weeks
- 3 weeks
- 1 month
- 2 months
- 3 months

- 4 months
- 5 months
- 6 months
- 7 months
- 8 months
- 9 months
- 10 or more months

11. How many total drinking occasions did you have between the ages of *(age of first use)* and *(age of first regular use)*? As a reminder, this was before you started drinking at least once a month so you should have less than 12 drinking occasions a year.
12. On average, how many standard drinks (cans of beer, glasses of wine, bottles of wine coolers, or drinks of liquor) did you have on each of those occasions?
 - 0
 - 1 or 2
 - 3 or 4
 - 5 or 6
 - 7, 8, or 9
 - 10 or more

Repeat questions 5–10 for each year up to their current age

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Figure 1.

Means of the two total volume CEDHF indices collapsed across time point, at session 1, at the 12- month follow-up, and at the 24-month follow-up. Means depict raw data not controlling for age or current drinking.

Figure 2.

Means of the two yearly average CEDHF indices collapsed across time point, at session 1, at the 12- month follow-up, and at the 24-month follow-up. Means depict raw data not controlling for age or current drinking.

Table 1.

Sample size, means, standard deviations, and ranges of all variables of interest

Measure	N	M	SD	Range
Age at Session 1	114	22.23	1.34	21–25
Age of Onset	303	16.41	2.52	10–23
Age of First Intoxication	303	17.24	2.72	10–23
Age of First Regular Use	303	18.99	2.19	13–25
Lifetime Total Volume Typical	303	2360.27	2503.98	40.50–10,800.00
Lifetime Total Volume Typical + Heavy	303	2545.03	2695.67	40.50–12,208.00
Yearly Average Typical	303	386.21	348.36	10.13–1,870.09
Yearly Average Typical + Heavy	303	415.90	365.26	10.13–1,948.64
TLFB Session 1	303	38.93	37.47	0.00–225.50
TLFB 12-Month Follow-Up	179	37.79	37.53	0.00–205.00
TLFB 24-Month Follow-Up	101	32.52	31.46	0.00–157.00
YAACQ Session 1	303	7.23	6.69	0.00–48.00
YAACQ 12-Month Follow-Up	181	6.42	8.11	0.00–48.00
YAACQ 18-Month Follow-Up	152	7.01	10.03	0.00–48.00
YAACQ 24-Month Follow-Up	83	4.48	5.89	0.00–33.00

Note: Means and standard deviations presented above are of the raw data. All outcome measures were log transformed in the analyses. Variables that do not specify a timepoint were collapsed across all three (session 1, 12-month follow-up, 24-month follow-up) timepoints

Table 2.

Correlations among the four CEDHF indices.

Measure	1	2	3	4
3. Lifetime Total Volume Typical	1.00			
4. Lifetime Total Volume Typical + Heavy	.99***	1.00		
5. Yearly Average Typical	.91***	.90***	1.00	
6. Yearly Average Typical + Heavy	.89***	.90***	.99***	1.00

Note: N=303, (173 men, 130 women);*
p < .05,**
p < .01,***
p < .001

Table 3.

Correlations among age of onset, age of first intoxication, the CEDHF, and outcome variables at all time points.

Measure	1	2	3	4	5	6	7	8	9	10	11
1. Age of Onset	1.00										
2. Age of First Intoxication	.87***	1.00									
3. CEDHF Lifetime Total Volume Typical + Heavy	-.36***	-.44***	1.00								
4. CEDHF Yearly Average Typical + Heavy	-.24***	-.29***	.90***	1.00							
5. TLFB Session 1	-.27***	-.27***	.42***	.46***	1.00						
6. TLFB 12-Month Follow-Up	-.29***	-.35***	.52***	.51***	.59***	1.00					
7. TLFB 24-Month Follow-Up	-.19	-.12	.39***	.35***	.42***	.51***	1.00				
8. YAACQ Session 1	-.32***	-.29***	.28***	.27***	.38***	.30***	.23*	1.00			
9. YAACQ 12-Month Follow-Up	-.19*	-.20**	.46***	.43***	.38***	.45***	.34**	.51***	1.00		
10. YAACQ 18-Month Follow-Up	-.13	-.07	.43***	.41***	.43***	.39***	.35***	.54***	.65***	1.00	
11. YAACQ 24-Month Follow-Up	-.13	-.13	.33***	.29**	.39***	.34***	.37***	.47***	.60***	.64***	1.00

* Note: $p < .05$,** $p < .01$,

 $p < .001$; Age of onset, age of first intoxication, and CEDHF indices are collapsed across timepoint

Table 4.

Summary of Cross-Sectional Regression Analyses Predicting Concurrent Alcohol- Related Problems

Block	Variable	Lifetime Total Volume		Yearly Average	
		β	<i>p</i> -value	β	<i>p</i> -value
1	Gender	−0.06	.284	−0.06	.284
	Age	−0.18	.002	−0.18	.002
2	Age of onset	−0.20	.001	−0.20	.001
3	Age of first intoxication	−0.16	.171	−0.16	.171
4	TLFB	0.41	< .001	0.41	< .001
5	CEDHF	0.20	.003	0.18	.013
	<i>Adjusted R²</i>	0 .235		0 .228	
	<i>F</i>	16.13 ***		15.56 ***	

Note: Standardized regression coefficients are reported given the small values of the unstandardized coefficients due to log transformation of the outcome measure.

N = 296;

*
p < .05,

**
p < .01,

p < .001

Table 5.

Summary of Longitudinal Regression Analyses Predicting 18-Month Alcohol-Related Problems

Block	Variable	Lifetime Total Volume		Yearly Average	
		β	<i>p</i> -value	β	<i>p</i> -value
1	Gender	0.03	.759	0.03	.759
	Age	−0.29	.002	−0.29	.002
	12-Month YAACQ	0.58	< .001	0.58	< .001
2	Age of onset	0.05	.599	0.05	.599
3	Age of first intoxication	0.02	.930	0.02	.930
4	12-Month TLFB	0.19	.089	0.19	.089
5	12-Month CEDHF	0.24	.042	0.21	.048
	<i>Adjusted R</i> ²	0.456		0.436	
	<i>F</i>	9.85 ***		9.17 ***	

Note: Standardized regression coefficients are reported given the small values of the unstandardized coefficients due to log transformation of the outcome measure.

* $N = 75$; $p < .05$,

** $p < .01$,

*** $p < .001$