

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

by

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## ABSTRACT

Adolescent and young adult alcohol use is a major public health concern given that it is the most widely used substance by teenagers. This is particularly concerning given the important biological and environmental changes that occur during this developmental period. Therefore, it is not surprising that alcohol use in adolescence is associated with a variety of negative outcomes including alcohol-related consequences, poor academic performance, aggression, and difficulty transitioning to adulthood. Because of this, it is imperative to better understand alcohol use during this time. While there are numerous measures that aim to capture adolescent alcohol use, there is not currently a measure that gathers comprehensive information on alcohol use across adolescence and into early adulthood. Therefore, we developed the Comprehensive Adolescent Drinking History Form (CADHF). The CADHF gathers detailed drinking information for each year since the onset of first regular use, including quantity and frequency of both regular use and periods of heaviest drinking. Additionally, the CADHF collects information on the participants' aggregate drinking experiences between their age of onset and age of first regular use. Using a sample of young adults who completed an alcohol challenge study, we sought to examine (1) whether route of administration of the measure impacts results, (2) which CADHF are most useful, and (3) whether the CADHF shows concurrent, convergent, and incremental validity. Results showed that, the CADHF can be administered online or over the phone and all eight indices provide valuable information depending on the research question. Additionally, strong significant correlations between the CADHF with the Timeline Follow Back (TLFB) and the Young Adult Alcohol Consequences Questionnaire (YAACQ) suggest convergent and

concurrent validity. Finally, the CADHF predicted concurrent and future alcohol-related problems over and above the gold standards of alcohol consumption measures; age of onset, age of first intoxication, and the TLFB. This is the first study to retrospectively assess participant's comprehensive alcohol consumption and fills a major gap in the literature. The CADHF has the potential to inform the timing of prevention and intervention efforts and provides unique information from the current gold standards of alcohol consumption measures.

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## CHAPTER 1

### INTRODUCTION

Adolescent and young adult alcohol use is a major public health concern. According to the Monitoring the Future study (MTF), alcohol is the most widely used substance by teenagers (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2015). Findings from MTF indicate that two-thirds of students have consumed alcohol by the time they graduate high school and about one-quarter have done so by 8th grade (Johnston et al., 2015). Further, almost half of students have gotten drunk by the time they leave high school and about 11% have done so by 8th grade (Johnston et al., 2015). This is particularly alarming given that adolescence is a critical developmental period marked by significant biological, cognitive, and social changes (Brown et al., 2009). During this time, the brain is developing rapidly, going through changes such as neurological and synaptic growth and pruning (Spear, 2000; Gogtay et al., 2004). This brain development enables adolescents to engage in more complex reasoning, making higher order executive functioning a larger part of their everyday lives (Gogtay et al., 2004). Moreover, because this time-period is marked by increased autonomy from parents and increased influence from peers and romantic partners, decision making becomes increasingly important. Therefore, it is critical that adolescents are able to consider goals, rewards, consequences, and social context when making decisions (Suzuki-Slakter, 1988). However, these processes that are involved in self-regulation and behavior inhibition are still developing throughout adolescence and young adulthood (Brown et al., 2009). Further, because reward and control systems develop at different rates during this time, adolescents are more sensitive to the rewarding aspects of risky



behavior (Casey, Jones, & Hare, 2008; Steinberg et al., 2008; Somerville, Jones, & Casey, 2010). Therefore, adolescents are at increased risk for engaging in hazardous levels of alcohol use (Clark, Thatcher, & Tapert, 2008; Bava & Tapert, 2010).

Not only are adolescents at risk for engaging in alcohol use, given the important biological and environmental changes that occur during this developmental period, adolescents who drink are more susceptible to alcohol-related consequences and a variety of negative outcomes. Spear (2000) found that the brain is particularly vulnerable to the toxic effects of alcohol during this time-period. Further, Ellickson, McCaffrey, Ghosh-Dastidar, and Longshore, (2003) suggested that adolescent alcohol use impairs development which results in additional problems that create difficulties in the transition to adulthood. This idea is supported by numerous other studies that demonstrate relations between alcohol use in adolescence and alcohol-related problems. For example, Bryant, Schulenberg, O'Malley, Bachman, and Johnston (2003) found that alcohol use during adolescence was associated with more misbehavior in school, association with deviant peers, and use of other dangerous substances. Additionally, they found that adolescents who consumed alcohol were less engaged and interested in school and performed worse academically (Bryant et al., 2003). Further, alcohol use during adolescence has been associated with increased aggression (White, Brick, & Hansell, 1993; Bonomo et al., 2001; Wells, Graham, Speechly, & Koval, 2005), conflicts with parents and other authority figures (Barnes, 1984; White and Labouvie, 1989), and physiological problems including vomiting and hangovers (Maney, Higham-Gardill, & Mahoney, 2002; Windle, 2003). In light of these adverse consequences, it is imperative to gather information on

adolescent drinking patterns in an efficient and valid manner in order to inform prevention and intervention efforts.

Researchers have used a variety of measures and strategies to capture alcohol use over the years. The earliest form of alcohol use measurement involved quantity/frequency measures. There have been numerous variations of these kinds of measures but the earliest that we could find in the literature dates 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. This basic approach has been adapted many times over the years to take into account variability in drinking days, type of beverage consumed, etc. (Maxwell, 1952; Mulford & Miller, 1960; Cahalan & Cisin, 1968; Cahalan, Cisin, & Crossley, 1969; Clark & Hilton, 1991).

More recently, Collins, Parks, & Marlatt (1985) developed the Daily Drinking Questionnaire (DDQ), which has been widely used over the past 30 years. This is also a quantity/frequency measure which was adapted from Cahalan, Cisin, and Crossley (1969). The DDQ consists of 4 questions relating to alcohol use (e.g. how often in the past three months have you had 1 or more drinks). Additionally, participants are asked to estimate the typical number of drinks they consumed on each day of the week during the last three months. Previous research has demonstrated that the DDQ is highly correlated with other measures of self-reported alcohol consumption (Kivlahan, Marlatt, Fromme, Coppel, & Williams, 1990).

While the DDQ is still used frequently, several other measures have also gained popularity. The 10 item Alcohol Use Disorder Identification Test (AUDIT) was

developed to screen for alcohol use disorders (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). The AUDIT assesses both consumption and problems resulting from alcohol use and has been shown to be a reliable and valid screening instrument (Foster, Blondell, & Looney, 1997; Harnett, Herring, & Thom, 1999; Davey, Obst, & Sheehan, 2000; Allen, Reinhart, & Volk, 2001; Reinhart & Allen, 2002). The first three items of the AUDIT pertain only to consumption and Bush, Kivlahan, McDonell, Fihn, and Bradley (1998) labeled these items the AUDIT-C. The AUDIT-C has been utilized in many studies as a brief measure of alcohol consumption and has been shown to be a good indicator of heavy alcohol use (Bradley, Bush, McDonell, Malone, & Fihn, 1998; Bush et al., 1998; Reid, Voynick, Peduzzi, Fiellin, Tinetti, & Concato, 2000; Gordon, Maisto, McNeil, Kraemer, Conigliaro, & Kelley, 2001).

While these measures have been shown to be good indicators of alcohol consumption, they do not provide detailed information about individual drinking occasions. Sobell and Sobell (1992) sought to address this issue by developing the Timeline Follow Back (TLFB) interview. 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 periods). On each drinking day, they are to report the number of standard drinks they consumed. The TLFB utilizes recall enhancement techniques to help the participant remember their drinking behaviors such as having them remember key dates during the time-period (e.g. holidays, birthdays, etc.). This measure has become somewhat of the gold standard in measuring 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 (Carney, Tennen, Affleck, Del Boca, & Kranzler, 1998; Searles, Helzer, & Walter, 2000).

Though all of these measures provide important information about alcohol use over a specified time period, none of them are able to give a comprehensive look at alcohol use across the lifespan. Getting a more complete picture of alcohol use over extended periods of time is essential in understanding how early alcohol use impacts development, including development of alcohol use disorders. This poses a question about whether individuals can reliably report on behaviors that occurred many years previously. Research suggests that people can in fact reliably remember events and behaviors throughout their life across multiple domains. More specifically, studies have shown that adults can reliably report on childhood behaviors and events such as parental behaviors, childhood trauma and neglect, and television viewing (Scher, Stein, Ingram, Malcarne, & McQuaid, 2002; Bremner, Bolus, & Mayer, 2007; Potts, Belden, & Reese, 2008). Individuals can also retrospectively report on risk taking behaviors such as substance use. Shillington, Cottler, Mager, and Compton (1995) found high agreement rates on reports of cannabis, opiates, sedatives, and cocaine use across a 10-year period, such that they reliably reported their age of onset of substance use and their accurately recalled their substance use at baseline at the 10-year follow-up. Similarly, Kenkel and colleagues (2002) found that participants' retrospective reports of their smoking habits were both reliable and accurate 8, 10, and 14 years later.

There is also an extensive literature examining whether individuals can report on previous alcohol use reliably, including studies that call the accuracy of retrospective reports of alcohol consumption into question. For example, in longitudinal studies, the

recanting phenomenon has occurred where individuals who endorsed alcohol use during a certain time later deny that alcohol consumption (Fendrich & Rosenbaum, 2003; Percy, Mcalister, Higgins, McCrystal, & Thornton, 2005). Researchers have also found that participants tend to underreport their alcohol use on the 30-day TLFB in relation to the 7-day TLFB (Hoeppner, Stout, Jackson, & Barnett, 2010) and real-time assessments (Searles, Helzer, Rose, Badger, 2002). However, there have also been numerous studies showing that adults can retrospectively report on their alcohol use reliably. Harris, Wilsnack, and Klassen's (1994) study showed high reliability between self-reported drinking histories given 5 years apart such that many participants gave the exact same report at each time point. Likewise, Chu and colleagues (2010) found high reliability of self-report measures of alcohol use when they reported on the same time frame 15 and 23 years later. Further, research on informant reports (e.g. parents, significant others, peers, etc.) of drinking show high correspondence with self-report data (Donahue, Hill, Azrin, Cross, & Strada, 2007; Hagman, Cohn, Noel, & Clifford, 2010). Moreover, self-report measures of drinking are more accurate than informant reports given that informants typically underestimate drinking levels when compared to self-report (Burlison & Kaminer, 2006; McGillicuddy & Eliseo-Arras, 2012). These results suggest that self-report measures of drinking history throughout the lifespan can provide valid and reliable information.

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 throughout 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 to measure lifetime drinking (Russell et al., 1998; Jacob, Seilhamer, Bargeil, & Howell, 2008). This provides support to the idea that people can reliably report on drinking behaviors across long periods of time.

The LDH and CLDH represent significant innovations in assessing comprehensive drinking histories. Although these measures are appropriate for older adults who have been through many decades of life or phases of drinking, they may not be the most appropriate measures for adolescents or young adults. Although these measures give important information on aggregate drinking experiences and capture the big picture of alcohol use across the lifespan, they do not provide detailed information on drinking behavior during the earliest stages of alcohol involvement during which there is often marked variability relative to later life stages. Thus, the goal of the current study is to develop a measure that provides better resolution for capturing early drinking histories from age of onset through adolescence. Better resolution will be obtained in three important ways. The first is that we will gather yearly reports of alcohol use from the

time that regular drinking begins, as opposed to averaging across a period of several years. Second, we will capture fluctuations in drinking patterns within each year by gathering data on periods of both typical and heaviest drinking. Third, we will capture the period between first drink and onset of regular drinking to provide comprehensive coverage from age of onset through adolescence. To our knowledge, there has been little effort to develop similar comprehensive measures of drinking history in adolescence. Rather, measures of early alcohol use tend to focus on age of onset or recent drinking (e.g., past 3 months, past year) rather than total amount consumed across early developmental periods.

Despite the limitations of existing measures of adolescent alcohol exposure, early alcohol use is consistently linked with risk for heavy drinking and related problems. Age of onset of alcohol use is one of the most common measures of adolescent alcohol use, and research has consistently shown an earlier age of first drink to be 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. Morean, Corbin, and Fromme (2012) showed that an earlier age of onset was associated with increased risk for both heavy drinking and alcohol-related consequences. Further, Hingson, Heeran, Levenson, Jamanka, and Voas (2002) found that those who started drinking earlier reported more incidents of driving while under the influence and motor vehicle accidents resulting from alcohol use. Earlier age of onset is also predictive of later alcohol use disorders. After controlling for other risk factors, Dawson, Goldstein, Chou, Ruan, and Grant (2008)

found that alcohol dependence rates were higher for individuals who began drinking before the age of 15, and alcohol abuse rates were higher for those who started drinking before the age of 17. In a longitudinal study, DeWit, Adlaf, Offord, and Ogborne (2000) showed that, after 10 years, about 14% of subjects who began to drink between the ages of 11 and 14 met criteria for a diagnosis of alcohol abuse, and 16% met criteria for a diagnosis of dependence. In contrast, rates of abuse and dependence for individuals who started drinking after the age of 19 were 2.0% and 1.0% respectively (Dewit et al., 2000).

Although there is considerable support for age of drinking onset as a risk factor, other longitudinal studies have called into question the strength and/or duration of these relations. 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 relations become weaker over time or that relations between age of onset and later drinking outcomes are more complex than originally thought (Labouvie, Bates, & Pandina, 1997; Afitska, Plant, Weir, Miller, & Plant, 2008; Maimaris & McCambridge, 2014). For example, recent studies have suggested that age of first intoxication is predictive of later drinking outcomes over and above age of onset (Warner & White, 2003; Warner, White, & Johnson, 2007). Additionally, Hingson, Heeren, and Winter (2006) found that college students who reported an age of first intoxication of 13 and under were more than three times as likely to develop an alcohol use disorder as those who reported an age of first intoxication of 19 or above. 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, results of these



studies suggest that relations between early use and later drinking outcomes are complex and that more information about adolescent alcohol use other than age of first use is needed to understand risk for negative drinking outcomes.

Although there are no comprehensive measures of alcohol exposure in adolescence, there have been efforts to assess adolescent alcohol related risk. For example, Mayer and Filstead (1979) developed the Adolescent Alcohol Involvement Scale (AAIS) to capture more detailed information about alcohol use during this time-period. The AAIS is a 14-item measure used to identify adolescents with an alcohol problem and is a compilation of previously validated indicators of alcohol misuse. The AAIS gathers information not only on quantity and frequency of alcohol use, but also on the effects it has on physiological functions, social relations, and the family living environment. Although this measure provides interesting and informative data on adolescent alcohol use and related problems, it does not provide detailed information about alcohol consumption across adolescence.

Efforts to develop comprehensive measures of alcohol use across early development are critical given the heterogeneity of alcohol use patterns during adolescence. Studies of drinking trajectories in adolescence highlight the potential value of such measures in capturing this heterogeneity. 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 (Stice, Myers, & Brown, 1998; Colder, Campbell, Ruel, Richardson, & Flay, 2002; Danielsson et al., 2010; Shamblen, Ringwalt, Clark, & Hanley, 2014). Unfortunately, these differences are lost in the current retrospective measures of adolescent drinking history as they do not

provide detailed information on alcohol consumption across the adolescent years. More specifically, these fluctuations in alcohol use could potentially make questions that average across adolescence an inaccurate representation of drinking behavior during this time. Thus, it is crucial to develop a measure that allows researchers to retrospectively gather information on these differences in order to get a better understanding of alcohol use in adolescence. This is particularly important during this time-period when there may not be a consistent pattern of drinking that persists over long periods of time.

Further, given the link between adolescent alcohol use and increased risk for alcohol-related problems and an alcohol use disorder diagnosis, it is imperative to develop a retrospective measure of alcohol use that can be administered during the highest risk time periods for the development of alcohol-related problems (adolescence and early adulthood). The transition from adolescence to adulthood (approximately between the ages of 18-30) represents a particularly critical developmental period that is characterized by heterogenous patterns of alcohol use (Auerbach & Collins, 2006; Brodbeck, Bachman, Croudace, & Brown, 2012). Given that alcohol use remains a large part of the collegiate environment, it is no surprise that levels of alcohol use tend to peak in the early to mid-twenties and then begin declining with age, known as “maturing out” (Jochman & Fromme, 2010). This decline could be due to the many life stage changes and identity/role development that occurs during this time (Gates, Corbin, & Fromme, 2016). However, there are also individuals who do not mature out of these heavy drinking patterns and ultimately experience significant problems later in life (Jackson, Sher, Gotham, & Wood, 2001). Because of this, the transition to adulthood represents a high-risk period for negative alcohol consequences and alcohol use disorder diagnosis. Thus,

there is a critical need to develop an alcohol use measure that provides detailed drinking information during adolescent and early adulthood as opposed to later stages of life where the LDH or CLDH would be more appropriate.

To address this gap in the literature, the current study sought to develop a retrospective comprehensive adolescent alcohol exposure measure geared towards adolescents and young adults (approximately under 30 years of age). The Comprehensive Adolescent Drinking History Form (CADHF) gathers information on age of onset, first intoxication, and first regular use. Additionally, it collects detailed information on each age since the onset of first regular use, including quantity and frequency of both regular use and periods of heaviest drinking. Finally, the CADHF collects information on the participants' aggregate drinking experiences between their age of onset and age of first regular use. To our knowledge, this is the first retrospective measure of adolescent alcohol use that provides such detailed information about drinking history during this time-period. The CADHF has the potential to provide more accurate and less heuristic based data than the current measures 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 the validity of this new measure, we examined relations between the CADHF and other measures of alcohol use and related problems allowing us to establish concurrent validity. We also examined the extent to which alcohol exposure from the CADHF shows incremental validity in the prediction of both concurrent and future alcohol-related problems when controlling for other common measures of alcohol use (e.g. TLFB, age of onset, and age of first intoxication).

## CHAPTER 2

### METHODOLOGY

#### *Measurement development*

The goal of the development of the current measure is to provide a more comprehensive look at adolescent alcohol use in a retrospective manner. To accomplish this, the CADHF incorporates age of onset and age of first intoxication questions. Additionally, it gathers information on shorter time periods than previous comprehensive drinking history measures by getting yearly reports of drinking behaviors. We also wanted to capture variability in drinking within each time-period, therefore, we asked about both typical and heavy drinking within each year. Finally, we asked about sporadic drinking that occurred between age of first use and age of first regular use to allow for computation of a lifetime alcohol exposure index.

#### *Participants*

Development of the CADHF took place in the context of a larger ongoing alcohol challenge study investigating the effects that social and physical contexts have on subjective responses to alcohol. The longitudinal parent study included 2 in-person sessions and 4 follow-up online/phone-interview sessions that took place across a two-year timespan. The parent study had full Institutional Review Board approval from the university in which it was being conducted. Eligibility criteria included binge drinking (5 or more drinks in one sitting for men/4 or more for women) at least once a month. Individuals were excluded from the study if they reported current clinical levels of anxiety or depression, met criteria for Alcohol Dependence, had previously participated in abstinence-oriented treatment programs, and for women, pregnancy. Additionally,

individuals who reported negative side effects of consuming alcohol were excluded to protect against undue discomfort. While the lightest and heaviest drinkers were excluded from the study, our sample is similar to nationally representative samples regarding their alcohol use (Grant, Stinson, & Hartford, 2001). Recruitment consisted of flyers placed around campus and the surrounding community and online advertisements.

### *Procedure*

Participants first came into the lab for a series of surveys and interviews to determine eligibility. The online version of the CADHF 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. Participants were randomly assigned to one of four contexts; individual lab, group lab, individual simulated bar, group simulated bar. All participants were randomly assigned by context to either a placebo condition or alcohol condition. Once age was verified and baseline BrAC's were taken to confirm they had not been drinking before the lab session, baseline alcohol response assessments were taken. For the participants who were placed in the alcohol condition, the volume of alcohol in each drink was adjusted by gender, age, height, and weight, with a target BrAC of .08 g%. Participants in both conditions were told they were drinking alcoholic beverages. Alcohol administration consisted of three drinks over 20 minutes (6 minutes per drink with a 1 minute resting period between each drink). After the 8-minute absorption period, BrACs were taken using a handheld breathalyzer in 10 minute intervals. Once the participant reached a BrAC of at least .06 g%, they began the alcohol response (AR) protocol. For more information on the contexts and detailed procedures, see Corbin and Richner (In Preparation).

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). Because the current study took place in the context of an ongoing study, some participants had already gone through the two in person sessions, therefore we administered the CADHF at either the 12-month or 24-month (if they had already completed the 12-month) follow-up for these participants. In all, 114 participants only completed the CADHF at session 1, 111 only completed the CADHF at the 12-month follow-up, 80 only completed the CADHF at the 24-month follow-up, and 2 participants took the CADHF at both the 12 and 24-month follow-up, making a total sample of 307 participants across the three time-points. For the purposes of the current study only participants who took the CADHF at only one time-point and reported alcohol use on the CADHF at least once in their lifetime were included in the analyses. In all, 2 people took the CADHF at multiple time-points and 2 people reported no drinking on the CADHF. This resulted in a final sample size of 303 participants.

### *Measures*

*Demographics.* Demographic variables included age, sex, race/ethnicity, marital status, most recent semester GPA, and socioeconomic status.

*Comprehensive Adolescent Drinking History Form (CADHF).* The CADHF 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). However, instead of aggregating across a long period of time, the CADHF includes questions about drinking behavior for each year starting with the

onset of regular drinking. For example, the CADHF 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?” These questions are repeated for each age up until the current age. Additionally, similar language is used to assess heaviest period of drinking each year. The CADHF 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 responds “yes,” the two questions outlined above for typical drinking are asked in reference to this heavy drinking time period for that year. 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 CADHF includes a question about aggregate drinking experiences from age of onset to when an individual first started drinking regularly. This allows for the creation of an index of total lifetime exposure (number of alcoholic drinks consumed) during adolescence. 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. As stated above, previous studies have shown the TLFB to be a reliable and valid retrospective alcohol use measure.

*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.



## CHAPTER 3

### DATA ANALYTIC PLAN

Prior to conducting the primary analyses, distributions of all variables were examined. The 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 we used two separate methods of administration for the CADHF (e.g. online at session 1 and phone interview at the 12 and 24-month follow-ups), we first conducted analyses to determine whether the type of administration/time-point impacted the results. This was accomplished using ANOVA to compare the means on the two versions while using the TLFB and current age as covariates to control for true differences in recent drinking between groups. We hypothesized that there would not be significant mean differences between the versions/time-points. If there were mean differences by method of administration/time-point, we examined whether these differences related to differences in results of the concurrent and incremental validity analyses by running separate analyses by method of administration and/or time-point. If there were not significant mean differences, we collapsed across type of administration and/or time-point and used the full sample for subsequent analyses.

Next, we conducted analyses to examine the concurrent, convergent, and incremental validity of the CADHF. These analyses involved correlation and regression analyses examining relations between indices of drinking from the CADHF and measures of alcohol use and problems outlined previously. The CADHF has the potential to yield

eight different drinking indices. The first two relate to the total volume of alcohol consumed since the onset of regular drinking. We calculated total volume in two ways. The first measure was based only on typical drinking assessed for each time-period. The second measure took into account both typical and heaviest drinking assessed for each time-period. In these approaches, the quantity and frequency values were multiplied to create a yearly drinking amount for each year since the onset of regular drinking and each year was summed to get the total amount of alcohol consumed (e.g., total number of drinks). Two additional measures captured yearly average levels of alcohol consumption since the onset of regular alcohol use. To accomplish this, the total volume of alcohol consumed was divided by the number of years over which the participant reported drinking since the onset of regular drinking. Again, this was done with and without consideration of periods of heavier drinking. The other four measures were similar (with and without heavy drinking periods for total volume and with and without heavy drinking periods for yearly average) but included the period of drinking between age of first use and first regular use, yielding a total of eight drinking indices in all. While the calculation of eight different CADHF indices may seem excessive, for the purposes of this validation study, we felt it was important to examine the full range of alcohol consumption indices the CADHF can produce to determine which aspects of the measure are most valuable. Use of measures of both total consumption and yearly consumption provides important information about the relative impacts of total exposure vs. averaged levels of consumption, and examination of measures with and without heavier periods of drinking provides important information about the relative added value of capturing fluctuations in drinking within time-periods. Further, including indices that gather a complete history of

drinking since first use versus only including information from first regular use provides valuable information regarding the relative impact of one's earliest drinking experiences.

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 each year impacted the results. This was done by testing for differences in the magnitude of correlations between the TLFB and the indices from the CADHF that did and did not include heavy drinking using the procedures outlined by Steiger (1980). There is a web application available that calculates the difference in magnitude of two dependent correlations using the Steiger (1980) method. This method involves inputting the correlations between each of the two measures of interest (the two CADHF indices) with the common measure (TLFB), along with the correlation between the two CADHF indices. Because we hypothesized that the inclusion of heavy drinking would provide added value, we predicted that we would conduct similar analyses to determine if measures that did and did not include drinking experiences between age of first use and first regular use relate differentially to another measure of alcohol use (TLFB) using only the CADHF indices that included both typical and heavy drinking (e.g. yearly average including heavy drinking vs. total volume including heavy drinking). We hypothesized that including the period from age of onset to age of first regular use would only lead to a stronger correlation with the TLFB for the total volume index and not the yearly average index. Including this period which is characterized by lower levels of alcohol use may lead to a decrease in the yearly average index and therefore may not accurately capture the participant's drinking experiences. Finally, we planned a set of correlation analyses to determine whether the total volume

index including the period between age of onset and age of first regular use and the yearly average index that did not include this period related differentially to measures of consumption and problems, using only the CADHF indices that included heavy drinking (e.g. lifetime total volume including heavy drinking vs. yearly average including heavy drinking). We hypothesized that the yearly average index without the earliest period of use would relate more strongly to measures of consumption such as the TLFB while the total volume index with the early drinking period would be more highly correlated with measures of alcohol-related problems such as the YAACQ. Given this hypothesis, we expected the subsequent analyses would be conducted using the yearly average (without early use) and lifetime total volume (with early use) indices that included both typical and heavy drinking periods.

To test for convergent validity, we examined correlations between the CADHF and the current gold standard of measuring alcohol use, the TLFB. Additionally, we tested for concurrent validity by assessing correlations between the CADHF and a common measure of alcohol consequences, the YAACQ. Finally, we assessed incremental validity using both cross-sectional and longitudinal regression analyses in SPSS. Because the predictor variables in both sets of analyses were expected to be substantially correlated we examined tolerance and the variance inflation factor (VIF) to ensure there were not multicollinearity problems in the data. A VIF value below ten and a tolerance value above .10 indicate that there are not significant multicollinearity issues that could impact interpretation of results (Tabachnick & Fidell, 2007).

Cross-sectional analyses utilizing the full sample examined whether the CADHF indices predicted concurrent alcohol-related problems (YAACQ) over and above other

measures of alcohol use including age of first use, age of first intoxication, and the TLFB. Covariates (e.g. age and gender), were entered in Block 1, while Blocks 2 through 5 added age of onset, age of first intoxication, the TLFB and the CADHF respectively. With regard to the longitudinal regression analyses, we used a subsample of 76 participants who were administered the CADHF at the 12-month follow-up and also completed the 18-month follow-up. We examined whether the CADHF at the 12-month follow-up predicted unique variance in future alcohol-related problems (YAACQ at the 18-month follow-up) over and above 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). We hypothesized that, in both the cross-sectional and longitudinal analyses, the CADHF indices would significantly predict alcohol-related problems over and above previously mentioned measures of alcohol use (and current alcohol problems in the longitudinal analyses).

## CHAPTER 4

### RESULTS

#### Preliminary Analyses

When examining the distributions, we found that the CADHF indices were skewed due to outliers in the distribution. Further, The TLFB and YAACQ distributions were skewed due to a large number of zero values. Therefore, we windsorized (replaced with the highest valid value in the distribution) the outliers (less than 2% of cases for each index) in the CADHF distributions. To adjust for the skewness in the TLFB and YAACQ distributions, we log transformed these data. After windsorizing and log transforming the distributions, none of the variables showed significant skewness (values were all under 2.00) or kurtosis (values ranged from 2.72 -3.71). Means, standard deviations, and ranges of all variables of interest are included in Table 1.

#### *Route of Administration/Timepoint*

We then used ANOVA controlling for participant's current age and their current drinking to test whether route of administration/timepoint (e.g. online at session 1 and phone interview at 12 and 24-month follow-ups) impacted the results. Results showed that when controlling for age and concurrent TLFB scores, route of administration/timepoint did not significantly impact either the four total volume indices or the four yearly average indices (Total volume: *Wilks'  $\lambda$*  = .958,  $F(8, 580) = 1.570$ ,  $p = .131$ ; Yearly Average: *Wilks'  $\lambda$*  = .952,  $F(8, 558) = 1.814$ ,  $p = .092$ ). 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, we collapsed across route of

administration/time-point in subsequent analyses. Means of all eight CADHF indices at each time-point, not controlling for age or current drinking, are depicted in Figures 1 and 2.

### *CADHF Indices*

Next we examined whether the different CADHF indices yielded different results by testing whether there were significant differences in the magnitude of correlations between the outcomes variables and the different CADHF indices using the Steiger (1980) method. Regarding the potential added value of including periods of heavy drinking, results showed that there was not a significant difference in correlations between the indices that did and did not include heavy drinking and the TLFB ( $z\text{-score} = 1.639, p = .10$ ). Correlations were non-significantly larger for the CADHF indices that did not include heavy drinking. However, because results were not significantly impacted by including heavy drinking, we chose to use the indices that included heavy drinking in subsequent analyses to take advantage of the more comprehensive information provided by these indices. The results regarding lifetime use depended on whether the indices were total volume or yearly averages. For the total volume indices, the correlation between the TLFB and the CADHF index that included the period between age of onset and age of first regular use was the same as the correlations between the TLFB and the CADHF index that did not include this period. However, for the yearly average index, the index that did not include this period was significantly more strongly related to the TLFB than the index that did include this period ( $z\text{-score} = 2.463, p = .014$ ). This could be because while including the period of drinking between age of onset and age of first regular use provides more comprehensive information for the total volume index, inclusion of this

information may be misleading for the yearly average index. Because total amount consumed between first use and first regular use is typically rather low and can span several years, including this information may result in a drastic decrease in the yearly average index for some participants. Therefore, we examined whether the total volume index that included the period of earliest drinking and the yearly average index that did not include this period were differentially related to TLFB and YAACQ scores. Results showed that there were not significant differences in the magnitude of correlations for either the TLFB or the YAACQ, however, the yearly average index was marginally more significantly related to the TLFB than the lifetime total volume index (TLFB:  $z\text{-score} = 1.236, p = .217$ ; YAACQ:  $z\text{-score} = .613, p = .540$ ). While not significantly different, the total volume and yearly average indices capture conceptually different aspects of drinking history. Therefore, subsequent analyses were conducted on only two CADHF indices. The first is the total volume index that includes the period between age of onset and age of first regular use and periods of heavy drinking. This index will be referred to as “lifetime total volume.” The second is the yearly average index which does not include the period between age of onset and age of first regular drinking, but does include heavy drinking. This index will be referred to as “regular drinking yearly average.” Again, these indices were chosen because we felt that they were the two indices that provided the most comprehensive drinking information while still accurately representing the data. Further, the correlation between these two indices was among the smallest of the correlations between all eight indices ( $r = .90$ ), suggesting that of all of the CADHF indices, they are among those which capture the most conceptually unique drinking information. Correlations among the eight CADHF indices are presented in Table 2.



## Primary Analyses

### *Convergent and Concurrent Validity*

Results suggest that the CADHF displays both convergent and concurrent validity. With regard to convergent validity, the total volume and yearly average CADHF indices were both significantly and strongly correlated with the TLFB (lifetime total volume:  $r = .372, p < .001$ ; regular drinking yearly average:  $r = .404, p < .001$ ). Results were similar for concurrent validity, such that both CADHF indices had a moderate significant correlation with the YAACQ (lifetime total volume:  $r = .303, p < .001$ ; regular drinking yearly average:  $r = .288, p < .001$ ).

### *Incremental Validity*

We then examined whether the CADHF predicted concurrent alcohol-related problems over and above other common measures of alcohol use. Results showed that while controlling for current age and gender, both the total volume and yearly average indices predicted unique variance in alcohol problems over and above age of onset, age of first intoxication, and concurrent TLFB (lifetime total volume: *Adjusted R*<sup>2</sup> = .235, SE = .388,  $p = .003$ ; regular drinking yearly average: *Adjusted R*<sup>2</sup> = .228, SE = .390,  $p = .013$ ).

Finally, we examined whether the CADHF accounted for unique variance in future problems over and above other common measures of concurrent drinking and current alcohol problems. Results showed a similar pattern of results to the cross-sectional analyses. When controlling for age and gender and current alcohol consequences, both CADHF indices at the 12-month follow-up were significant predictors of alcohol-related problems 6 months later over and above age of onset, age of

first intoxication, and the 12-month TLFB. (life-time total volume: *Adjusted R*<sup>2</sup> = .456, SE = .337, *p* = .042; regular drinking yearly average: *Adjusted R*<sup>2</sup> = .436, SE = .343, *p* = .048). Correlations among the two CADHF indices and the outcome measures at all time-points are presented in Table 3. Further, standardized regression coefficients and model summary information are included in Tables 4 and 5.

## CHAPTER 5

### DISCUSSION

The current study aimed to develop and examine a novel retrospective measure of adolescent alcohol exposure, the CADHF. This measure incorporates questions about participants' age of first use, age of first intoxication, and the age at which they started to drink regularly (binge drinking at least once a month), along with gathering detailed quantity and frequency information on their typical and heavy drinking periods each year from the time they started drinking regularly to their current age. The CADHF also collects information about aggregate drinking experiences from age of first use to the age that an individual starts regularly 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 alcohol exposure. We sought to determine whether route of administration impacted the results, which CADHF 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 CADHF online or over the phone when controlling for their age at the time of assessment. Further, the raw means increased at each assessment time-point. This supports the validity of the measure given that participants should be reporting greater drinking at each time-point since they have more years in which to report on their drinking. These findings also suggest that future researchers can administer the CADHF over the phone or online depending on their needs and resources. If time efficiency is

important, online administration will be able to reach the most participants with the least amount of time and labor.

To determine which CADHF indices were of most use, we used the Steiger (1980) method to test for differences between the magnitudes of a series of correlations between the CADHF indices and the TLFB and YAACQ. The only significant difference was between the yearly average heavy drinking indices that did and did not include the period of time between age of first use and age of first regular use. The regular drinking yearly average index was significantly more strongly correlated to the TLFB than the lifetime total volume index. Therefore, we decided to use the two indices that we felt conceptually fit our research questions using the information provided by the correlation tests. We felt that the total volume including sporadic alcohol use before the age of regular drinking and yearly average drinking from the onset of regular drinking answer theoretically different questions. Further, for the purposes of this validation study, we wanted to use the indices that provided the most comprehensive information while still providing an accurate representation of the data. Thus, we used indices that included periods of heavier as well as typical drinking. Based on these criteria, we decided to use lifetime total volume (including heavy drinking) and regular drinking yearly average (including heavy drinking) as the two CADHF indices in our further analyses.

When we tested whether the CADHF demonstrated convergent and concurrent validity, results supported the validity of the CADHF given the large significant correlations between our indices and concurrent TLFB and YAACQ scores. Additionally, we examined incremental validity both cross-sectionally and longitudinally. Not only did the CADHF predict concurrent alcohol-related problems over and above other common

measures of alcohol use (e.g. age of onset, age of first intoxication, TLFB), it also predicted alcohol-related problems over and above these measures 6-months later. Therefore, the CADHF demonstrates convergent, concurrent, and incremental validity.

These results suggest that the CADHF 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 adolescent alcohol use. The CADHF was able to predict concurrent and future alcohol consequences over and above these measures suggesting that using this measure is not only preferable to other measures but also necessary in order to get a better understanding of adolescent alcohol use. It is also important to note that, in the longitudinal analyses, the TLFB did not predict alcohol consequences 6-months later. Given that the TLFB is the current gold standard for measuring alcohol use, this speaks to the value and need for a more comprehensive measure like the CADHF.

While these indices were useful for the purposes of the current study, future researchers may find other indices more appropriate. For example, if brevity is a priority, questions about heavy drinking and the period between age of onset and age of first regular use could be removed. Further, the more comprehensive total volume indices lend themselves to 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](http://ncanda.org)) and the Adolescent Brain Cognitive Development Study ([addictionresearch.nih.gov](http://addictionresearch.nih.gov)). In contrast, the yearly average indices may be more appropriate for studies that need trajectory like information. Additionally, the indices that include heavy drinking may be better suited for heavy drinking samples

where this would provide more unique information while the typical drinking indices may be sufficient for lighter drinking samples that do not have many instances of heavy drinking.

The current study fills an important gap in the literature by developing the first comprehensive adolescent alcohol exposure measure, however, there are limitations that should be considered. First, the CADHF 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 (Harris et al., 1994; Burleson & Kaminer, 2006; Donahue et al., 2007; Chu et al., 2010; Hagman et al., 2010; McGillicuddy & Eliseo-Arras, 2012), there are also studies that call the accuracy of these types of retrospective self-report measures into question (Searles et al., 2002; Fendrich & Rosenbaum, 2003; Percy et al., 2005; Hoepfner et al 2010). Given that there are not currently any other measures that gather this type of detailed drinking information across this length of time, there are no direct comparisons about the reliability of our retrospective measure. However, the LDH has repeatedly been shown to have high reliability and gathers information (while not as detailed as the CADHF) across several decades (Russell et al., 1998; Jacob et al., 2008). This suggests that it is possible for individuals to reliably report on their drinking behaviors over long periods of time. Although most researchers will not have the time or resources to gather prospective reports of drinking from adolescence through early adulthood, future research is needed to compare CADHF data to prospective reports of drinking in order to further test the reliability and accuracy of this measure. While such research would further support use of the CADHF, even without such evidence, one could argue that using the CADHF is a

better option than simply asking about age of onset and age of first intoxication, an approach that is common in the literature.

Another main limitation of this study pertains to the characteristics of the current sample. As outlined previously, the CADHF 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., 30s or older). The CADHF 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 (Jackson et al., 2001; Auerbach & Collins, 2006; Brodbeck et al., 2012). The current study was only able to include participants ages 21-27, because of this, we do not know how this measure or the results of this study will hold up when using older or younger samples. While we do not have reason to assume that this measure would not be appropriate for younger populations, future researchers would benefit from administering the CADHF to individuals from different age groups to determine its reliability and validity across the life-span.

This study also excluded light drinkers and those with past three-month AUD diagnosis. It is possible that the results of this study could appear differently in the general population. It is possible that very light drinkers would have later age of onset and age of first intoxication and have very few heavy drinking periods. This could not only impact the added value of the CADHF over these other measures but also the indices that would be most appropriate. If the sample contained more lighter drinkers, using the indices that did not include heavy drinking may have been the better option.

Excluding very heavy drinkers could have also affected the results. Most likely, those with past three-month diagnosis would have experienced greater alcohol-related problems than those without this diagnosis. Having greater variability in alcohol-related problems could impact the relation between the CADHF and alcohol consequences. Future studies using a full range of drinkers are needed to provide further information about the generalizability of our findings.

Finally, the current study was only able to examine alcohol-related problems 6-months later. Like adolescence, young adulthood is characterized by heterogeneous drinking patterns and alcohol use can fluctuate significantly across this time-period (Jackson et al., 2001; Auerbach & Collins, 2006; Brodbeck et al., 2012). Only examining relations across a 6-month time period may not provide the best picture of young adult alcohol use given these fluctuations and important life events that occur during this period. Therefore, future studies are needed to determine if the results found in the current study are upheld over longer stretches of time.

Despite these limitations, this study contributes to the literature by developing and assessing the psychometric properties of the first truly comprehensive adolescent drinking history measure and has important implications and potential for future research. As discussed previously, adolescence and young adulthood are critical time periods for understanding risk for AUD's (Jackson et al., 2001; Auerbach & Collins, 2006; Brodbeck et al., 2012). The results of this study suggest that the CADHF could provide valuable information about who is at highest risk for the development of AUD's and 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 CADHF is so time and cost effective, researchers can now gather this type of information on a much larger scale and get a reasonable understanding of how adolescent alcohol consumption impacts future use and problems. Further, given that it collects data on lifetime drinking experiences, the CADHF 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.

It is also important to note that this study which focused on initial validation of the measure did not take full advantage of all the data the CADHF provides. Because it gathers data on drinking experiences each year since age of first regular use, this measure has the capability to provide trajectory like information. Adolescence and young adulthood are characterized by heterogeneous drinking patterns and these patterns can differentially relate to later risk (Stice et al., 1998; Colder et al., 2002; Danielsson et al., 2010; Shamblen et al., 2014). For example, if two adolescents or young adults are current moderate drinkers but one began drinking heavily early on but truncated their use over time and the other one began as a very light drinker and increased their use over time; they would theoretically have a different pattern of risk given that one has an increasing alcohol use trend while the other has a decreasing trend. Additionally, drinking trajectories can provide valuable information about how risk factors (e.g. family history, genetics, comorbid mental health problems, etc.) contribute to later alcohol use. For example, trajectories can be used to answer questions regarding how genes and the

environment interact to impact alcohol patterns and how a family history of alcohol use and other parental behaviors can lead to differential patterns of alcohol consumption in adolescence. Therefore, it is imperative to be able to capture these differences in order to get a better understanding of the development, precursors to, and consequences of heavy alcohol use. Researchers should consider using this trajectory like data in future studies.

This is also the first alcohol consumption measure that includes detailed drinking information along with drinking benchmarks (age of first use, age of first intoxication, age of first regular use). It is possible that the order or separation between these benchmarks could lead to differential risk for later alcohol-related problems. For example, someone who has their first drink at age 14 but does not start drinking regularly until 21 may show less risky drinking patterns later in life than someone who has their first drink at 15 and starts to drink regularly at age 16. Further, someone who becomes intoxicated before they start drinking regularly may develop heavier drinking habits than someone who drinks small amounts of alcohol regularly but does not become intoxicated until a later point in time.

Overall, the current study supports the validity and utility of the CADHF, a novel measure of adolescent alcohol exposure. To our knowledge, this is the first study to retrospectively assess participant's alcohol consumption in a comprehensive manner across their lifespan and fills a major gap in the literature. The CADHF has the potential to inform the timing of prevention and intervention efforts and provides unique information from the current gold standards of alcohol consumption measures. Future research using the CADHF may provide important new insights regarding the impact of adolescent alcohol exposure. Studies comparing the CADHF to prospective reports of

drinking and utilizing this measure in different populations (e.g., different age groups) to better understand the development and consequences of heavy alcohol use and to determine who is at risk for later AUD diagnoses would be particularly valuable.

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**Table 1.**

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

Measure	N	M	SD	Range
Age at Session 1	112	22.22	1.34	21-25
Age at 12-Month Follow-Up	111	23.86	1.34	22-27
Age at 24-Month Follow Up	80	24.39	1.19	22-27
Age of Onset	303	16.42	2.52	10-23
Age of First Inoxication	303	17.3	2.54	10-23
Age of First Regular Use	303	18.99	2.19	13-25
Total Volume Typical	303	2250.86	2423.21	36.00-9,947.00
Total Volume Typical + Heavy	303	2452.93	2690.62	36.00-12,153.00
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
Lifetime Yearly Average Typical	303	290.75	282.98	8.10-1,377.33
Lifetime Yearly Average Typical + Heavy	303	311.73	303.96	8.10-1,714.79
TLFB Session 1	303	37.47	36.05	0.00-225.50
TLFB 12-Month Follow-Up	179	37.79	37.53	0.00-205.00
TLFB 24-Month Follow-Up	101	32.53	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 eight CADHF indices.

Measure	1	2	3	4	5	6	7	8
1. Total Volume Typical	1.00							
2. Total Volume Typical + Heavy	.99***	1.00						
3. Lifetime Total Volume Typical	.99***	.99***	1.00					
4. Lifetime Total Volume Typical + Heavy	.99***	.99***	.99***	1.00				
5. Yearly Average Typical	.90***	.90***	.91***	.90***	1.00			
6. Yearly Average Typical + Heavy	.90***	.90***	.89***	.90***	.99***	1.00		
7. Lifetime Yearly Average Typical	.91***	.91***	.92***	.91***	.96***	.94***	1.00	
8. Lifetime Yearly Average Typical + Heavy	.91***	.91***	.91***	.92***	.95***	.95***	.99***	1.00

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

**Table 3.**

Correlations among the CADHF and outcome variables at all time points.

Measure	1	2	3	4	5	6	7	8	9
1. CADHF Lifetime Total Volume Typical + Heavy	1.00								
2. CADHF Yearly Average Typical + Heavy	.90***	1.00							
3. TLFB Session 1	.42***	.46***	1.00						
4. TLFB 12-Month Follow-Up	.52***	.51***	.59***	1.00					
5. TLFB 24-Month Follow-Up	.39***	.35***	.42***	.51***	1.00				
6. YAACQ Session 1	.28***	.27***	.38***	.30***	.23*	1.00			
7. YAACQ 12-Month Follow-Up	.46***	.43***	.38***	.45***	.34**	.51***	1.00		
8. YAACQ 18-Month Follow-Up	.43***	.41***	.43***	.39***	.35***	.54***	.65***	1.00	
9. YAACQ 24-Month Follow-Up	.33**	.29**	.39***	.34***	.37***	.47***	.60***	.64***	1.00

Note: \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 4.

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

Variable	Lifetime Total Volume		Yearly Average	
	$\beta$	$p$ -value	$\beta$	$p$ -value
Gender	0.03	.607	0.01	.789
Age	-0.18	.002	-0.12	.021
Age of onset	-0.02	.421	-0.09	.380
Age of first intoxication	0.01	.661	0.01	.930
TLFB	0.33	< .001	0.36	< .001
CADHF	0.20	.003	0.18	.013
<i>Adjusted R<sup>2</sup></i>	.235		.228	
<i>F</i>	16.13***		15.56***	

*Note:* Standardized regression coefficients are reported given the small value of the unstandardized coefficients due to including log transformed data.

$N = 296$ ; \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

Table 5.  
Summary of Longitudinal Regression Analyses Predicting 18-Month Alcohol-Related Problems

Variable	Lifetime Total		Yearly Average	
	$\beta$	<i>p</i> -value	$\beta$	<i>p</i> -value
Gender	0.06	.502	0.06	.515
Age	-0.32	.001	-0.27	.003
12-Month YAACQ	0.49	< .001	0.52	< .001
Age of onset	-0.03	.890	0.05	.795
Age of first intoxication	0.13	.548	0.04	.852
12-Month TLFB	0.09	.344	0.12	.232
12-Month CADHF	0.24	.042	0.21	.048
<i>Adjusted R</i> <sup>2</sup>	.456		.436	
<i>F</i>	9.85***		9.17***	

*Note:* Standardized regression coefficients are reported given the small value of the unstandardized coefficients due to including log transformed data.

*N* = 75; \**p* < .05, \*\**p* < .01, \*\*\**p* < .001

## FIGURE CAPTIONS

Figure 1. Means of all four total volume CADHF 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 all four yearly average CADHF 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 1.

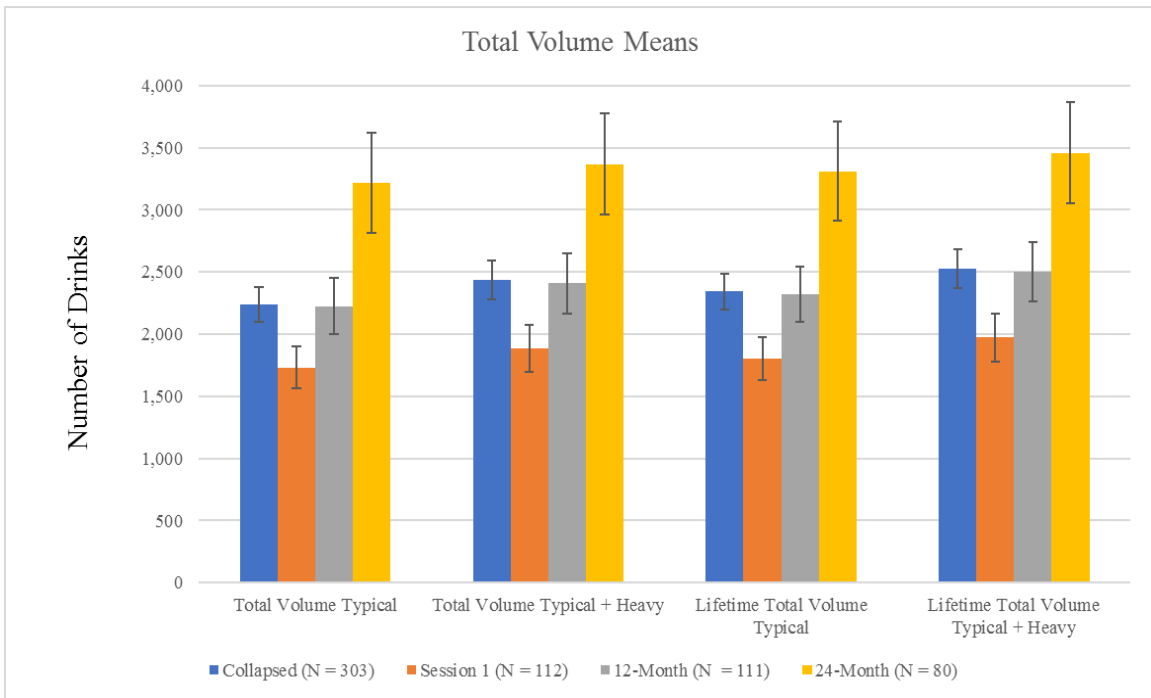
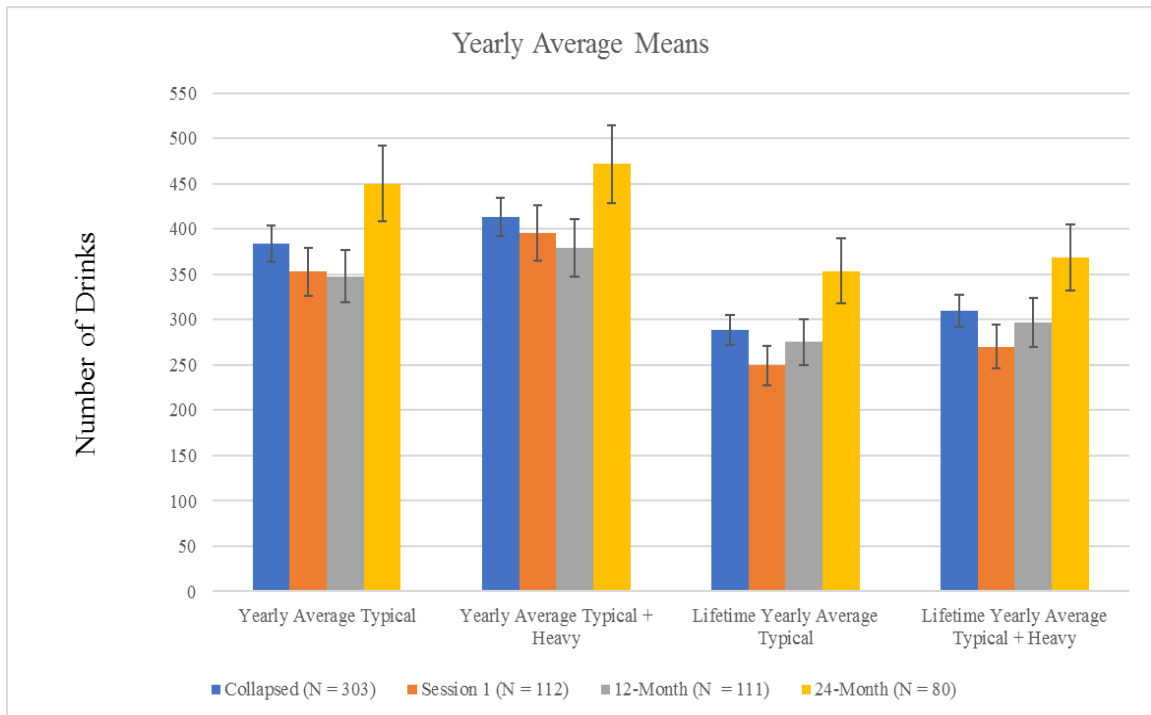


Figure 2.



APPENDIX A

COMPREHENSIVE ADOLESCENT 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)?

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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\*\*\*