

HIGH INTENSITY DRINKING: PREVALENCE AND CORRELATES IN A
COMMUNITY-BASED SAMPLE OF AUSTRALIAN ADULTS

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HIGH INTENSITY DRINKING IN AUSTRALIAN ADULTS

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Abstract

Many adult drinkers consume far beyond the established binge threshold (i.e., 4/5+ drinks for women and men, respectively). High intensity drinking (HID), defined in two levels at two (high intensity low [HIL]) and three (high intensity high [HIH]) times the binge threshold, is associated with more frequent and severe drinking-related consequences. This study examined the prevalence of past year HID in a sample of adult drinkers, as well as the relative associations of demographic characteristics, Big Five personality traits, family history of alcohol problems, childhood externalizing disorders, perceived peer drinking, and drinking-related consequences with binge drinking versus HID. Sex differences were also examined. Prevalence of past year HIL and HIH were both 22%, with men disproportionately represented in these categories. Quantity and frequency measures of alcohol use differentiated HIL and HIH from the binge group. Being male, younger, less educated, and unmarried were associated with HID; high extraversion and low agreeableness and conscientiousness, twin and current partner history of alcohol problems, and ADHD and conduct disorder were all associated with higher odds of HIH specifically; few effects emerged for HIL compared to binge. Perceiving a higher proportion of heavy drinking friends significantly increased odds of each successive drinking level. Rates of alcohol-related consequences were significantly higher in each successive drinking group. Sex differences emerged in the associations of income, marital status, openness to experience, conscientiousness, male friend drinking, and alcohol use disorder with HID. HID is a novel construct, but a prevalent behavior that warrants further empirical attention and more specified methodological approaches.

High Intensity Drinking: Prevalence and Correlates in a
Community-Based Sample of Australian Adults

Heavy drinking is a focus of much research and public health effort due, in large part, to its high cost at both individual and societal levels; three-quarters of the \$249 billion cost related to alcohol use in the United States (US) in 2010 was related to binge drinking (i.e., 4+/5+ drinks in one drinking occasion for women/men, respectively; Sacks, Gonzales, Bouchery, Tomedi, & Brewer, 2015). The construct of binge drinking has typically been utilized to understand hazardous alcohol use and its consequences, which include accidental injury and death, risky sexual behavior, vomiting and alcohol poisoning, passing and blacking out, and alcohol use disorder (AUD; Hingson, Zha, & White, 2017; NIAAA, 2004; Patrick & Azar, 2017; Townshend, Kambouropoulos, Griffin, Hunt, & Milani, 2014; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). Individual risk factors for binge drinking have been consistently identified, including being male, aged 18-25, and unmarried, having lower levels of educational attainment (Hingson et al., 2017; Kanny, Liu, Brewer, & Lu, 2013; Kanny, Naimi, Liu, Lu, & Brewer, 2018; Naimi, Nelson, & Brewer, 2010), and endorsing higher levels of extraversion and lower levels of agreeableness and conscientiousness (Raynor & Levine, 2009). However, there is growing debate in the field as to how best approach understanding more extreme alcohol use behavior that surpasses the binge threshold. This type of drinking has typically been included under the umbrella of binge drinking without distinction, although it appears as though there may be utility in parsing out different levels of heavy drinking as a means of better understanding risk factors and alcohol-related consequences in particular populations of alcohol consumers (White, 2017). High

intensity drinking (HID), defined in two levels as 8-11/10-14 (i.e., 2 times the binge threshold) and 12+/15+ (i.e., 3 times the binge threshold) drinks in a single drinking episode for women/men, respectively, has been proposed as a construct to describe and understand alcohol use that significantly surpasses the binge threshold (Patrick & Terry-McElrath, 2017; White, Kraus, & Swartzwelder, 2006), with specific calls for research on the topic (Patrick, 2016).

Demographic characteristics, personality traits, and childhood and developmental factors represent relatively stable individual characteristics that could provide utility in understanding factors that contribute to engagement in HID. HID research has thus far primarily focused on rates and outcomes of this behavior, mostly in adolescents and young adults (Patrick, Crouce, Fairlie, Atkins, & Lee, 2016; Patrick & Terry-McElrath, 2017; Patrick, Terry-McElrath, Kloska, & Schulenberg, 2016), with less attention paid to potentially predisposing factors that may place certain individuals, including mid-life adults, at higher risk for engaging in this type of drinking (Linden-Carmichael, Vasilenko, Lanza, & Maggs, 2017; Naimi et al., 2010). Thus, the study at hand sought to examine individual-level risk factors for HID, including demographic characteristics, personality traits, family history of alcohol problems, childhood drinking and externalizing disorders, perceived peer drinking behavior, and alcohol-related consequences, with particular attention to sex differences in how these factors are associated with HID. The group of correlates included in this study may be conceptualized as somewhat of a contextual model (Roos & Witkiewitz, 2017) that includes “person-level dispositions and characteristics” (e.g., demographic characteristics, personality traits, psychiatric conditions, and degree of substance

engagement), and “environmental conditions” (e.g., family history of alcohol problems, perceived alcohol use among current male friends, female friends, and coworkers). These factors were selected for study in part because, taken together, they span from childhood to current context; while the data presented are cross-sectional, this timeline of correlates may serve as a guide or framework from which to view this investigation.

Binge Drinking: Background, History, and the HID Movement

The definition of binge drinking, also often referred to as “risky drinking” and “heavy episodic drinking,” was approved by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) in February 2004 (NIAAA, 2004). It describes binge drinking as “a pattern of drinking alcohol that brings the blood alcohol concentration (BAC) to 0.08 gram percent or above. For the typical adult, this pattern corresponds to consuming 5 or more drinks (male), or 4 or more drinks (female) in about two hours” (NIAAA, 2004). Although the five drink threshold was established as early as the 1960s (Cahalan, 1969; Cahalan, Cisin, & Crossley, 1969; Kuntsche, Kuntsche, Thrul, & Gmel, 2017; White, 2017), the binge drinking definition utilized today was developed by substantial research in the 1990s, at which point it gained traction in the field (Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996; Wechsler & Austin, 1998; Wechsler et al., 1994; Wechsler, Dowdall, Davenport, & Castillo, 1995; Wechsler, Dowdall, Davenport, & Rimm, 1995; Wechsler, Lee, Kuo, & Lee, 2000). Wechsler and colleagues’ (1994) seminal article on binge drinking, which contributed substantially to the establishment of the binge cut point used today, focused on prevalence and consequences in college students. The study found that almost half of college students reported binge drinking in the two weeks prior to responding to the survey; roughly one-fifth were frequent binge

drinkers. This research was novel in its examination of alcohol-related problems and sex differences specific to binge drinking, providing evidence that frequency of binge drinking is associated with the frequency, quantity, and severity of alcohol-related problems, such as drinking and driving, injury, and unprotected or unwanted sex. Further, men and women were found to experience alcohol-related problems with similar frequencies, except for damaging property and getting into trouble with campus police, which were significantly more frequent among men. These findings shed initial light on establishing a cut point of alcohol use at which drinking moves from being “risky” to being more likely to result in the actualization of alcohol related problems and consequences.

Problematically, the field’s definition of binge drinking and implementation of the construct in research and public health contexts have loosened since NIAAA implemented its biometrically grounded definition (Courtney & Polich, 2009). In fact, a recent NIAAA publication described binge drinking as “broadly defined as consuming a large amount of alcohol in a short period of time” (NIAAA, 2017). Many studies in recent years have operationalized binge drinking in similarly lenient ways, often forgoing a BAC threshold and/or omitting queries about how rapidly drinks are consumed in favor of defining a binge episode as 4/5 drinks for women/men on a single drinking occasion (Jester et al., 2015; Kuntsche et al., 2017; Tan, Denny, Cheal, Sniezek, & Kanny, 2015; White, 2017). This has perhaps compounded the already existing problem of overgeneralization of risky drinking and a progressively lowering threshold of what constitutes it (Kuntsche et al., 2017; White, 2017); as it stands, many individuals qualify as binge drinkers without having met the legal standard of intoxication (i.e., .08 gram

percent BAC) during a “binge” episode (Thombs, Olds, & Snyder, 2003; White et al., 2006).

Despite the muddied waters of inconsistent operationalization, this public health approach to understanding the risks and consequences associated with binge drinking has demonstrated great utility in gauging the global burden of alcohol use (Kuntsche et al., 2017; World Health Organization [WHO], 2014). In fact, Wechsler and Nelson (2001) actively argued against specifying additional levels of binge drinking, as the binge definition serves a specific public health (e.g., population surveillance of risk), rather than clinical (e.g., diagnostic), function (Wechsler & Nelson, 2006). This issue was highlighted in a special issue of *Alcoholism: Clinical and Experimental Research*, in which a study by White and colleagues (2006) examining drinking beyond the binge threshold in college students was run parallel to an associated commentary by Wechsler and Nelson (2006). In their study, White and colleagues (2006) found that many college students drink far beyond the binge threshold, with one in five males and one in ten females drinking to the lower HID threshold in the two weeks prior to survey administration. The authors asserted that this type of extreme drinking should be a focus “in addition to binge drinking per se” (p.1010), arguing that, despite the binge threshold’s utility in accounting for the increased likelihood of experiencing drinking related consequences, those who are experiencing a particular set of extreme consequences (e.g., overdose) are likely to be (if not necessarily are) drinkers significantly surpassing the binge threshold; in other words, drinkers surpassing the binge threshold not only experience more consequences, but also experience different ones. Wechsler and Nelson (2006) critiqued this idea and the assertion that the binge threshold is too low to identify

at-risk drinkers and those experiencing severe consequences, highlighting that this is an issue of sensitivity versus specificity: a higher threshold may be more accurate, but may also overlook a substantial proportion of those experiencing harms while drinking at a lower level. Although Wechsler and Nelson (2006) further argued that White and colleagues' (2006) conclusion was precluded because their study did not include measures of drinking-related consequences, it has become increasingly clear that individuals engaging in HID do indeed experience alcohol-related consequences of higher severity and at substantially higher rates than do binge-only drinkers (Hingson et al., 2017), indicating the importance of examining this phenomenon.

Alcohol use exists on a broad spectrum, and, while a single threshold has inarguably demonstrated utility in a population level, epidemiological context, it is difficult to disentangle specific risks and consequences of drinking behavior from a more individualized, clinical perspective when using a dichotomous approach. Many adult drinkers consume alcohol well beyond this binge threshold, at a mean of 8 drinks during a binge episode (Naimi et al., 2010). Furthermore, there appear to be systematic differences between individuals who engage in HID and those who do not, which may be overlooked in categorizing all heavy drinkers as bingers. The construct of HID provides a framework within which to investigate more extreme forms of drinking behavior by integrating additional gradations to the construct in the form of levels based on drink quantity. This finer-grained approach to conceptualizing heavy drinking has garnered empirical support (Hingson et al., 2017; Patrick & Azar, 2017; Patrick & Terry-McElrath, 2017).

Consequences Associated with HID. There are functionally important differences between those who drink at the binge level only and those who significantly exceed it, including factors that precipitate the behavior and consequences that result from it (Hingson et al., 2017; Patrick, 2016; Patrick & Azar, 2017; Patrick, Evans-Polce, Kloska, Maggs, & Lanza, 2017). Binge drinking has been specifically distinguished due to its utility in demarcating the level of alcohol consumption associated with drinking-related harms; those who binge are significantly more likely to experience these harms as compared to drinkers who do not exceed the established threshold (Wechsler et al., 1994). However, individuals engaging in past year HID experience more severe drinking related consequences and do so with higher frequency than do binge-only drinkers (Hingson et al., 2017). Consumption at the binge threshold requires rapid consumption to meet the legal BAC limit in the US, and many drinkers do not exceed this during an episode of consuming at a binge level (Thombs et al., 2003; White et al., 2006). Conversely, even after a full meal, a woman and man of average weight would reach BACs of 0.30 and 0.20, respectively, if consuming three times the binge threshold over the course of four hours (Hingson & White, 2013; Hingson et al., 2017). This greatly increases risk of harms such as blackout, which is possible at BACs of 0.15% and higher (White & Hingson, 2013), and there is a 50% chance of experiencing alcohol induced amnesia at a BAC of 0.22; this likelihood continues to increase linearly with BAC (Perry et al., 2006). Thus, many binge-only drinkers are necessarily precluded from experiencing many alcohol-related consequences that require having attained a high BAC, such as driving under the influence, passing out, and blacking out, while HID drinkers are substantially more likely to achieve a high enough BAC to experience these

problems even when not consuming rapidly. The relative likelihood and severity of HID consequences presents higher risk to the individual and a higher societal cost than that of binge drinkers, indicating substantial differences between these groups (e.g., willingness to experience these consequences) that may be of clinical and public health relevance.

Consistent with the demonstrated dose-response relationship between number of drinks consumed/BAC and increasing risk of adverse outcomes, HID is, overall, associated with more negative drinking-related consequences as compared to binge drinking (Naimi et al., 2010; Patrick, Cronce, et al., 2016; Vinson, Maclure, Reidinger, & Smith, 2003; Zador, Krawchuk, & Voas, 2000). Adults engaging in past year HID had higher odds of blacking out, emergency department visits, driving under the influence of alcohol, and alcohol related legal problems as compared to individuals who did not exceed binge-level consumption. There is also evidence for differential outcomes between the two HID levels: individuals drinking to the higher level of HID had higher odds of injury, physical fights, and getting arrested as compared to individuals drinking to the lower level (Hingson et al., 2017). Some research has also shown that the motivational mechanisms underlying HID can be distinguished from those of binge drinking, such that high intensity drinkers more highly endorse drinking because of anger, boredom, wanting to cope with problems and feel good, and to sleep than do binge-only drinkers (Patrick et al., 2017). This implies a variable set of consequences and potentially distinct motives, decision making processes, and (dis)inhibitory processes across these patterns of alcohol consumption. Examining all drinking-related consequences through the lens of binge may preclude a more nuanced understanding of them, and who is experiencing them.

In addition to its association with immediate alcohol-related consequences, HID is also associated with AUD. While there is substantial evidence that heavy drinking in general is related to this outcome (Hingson et al., 2017; Wechsler & Nelson, 2006), individuals engaging in HID are three times more likely to meet criteria for a diagnosis than individuals who do not exceed the binge threshold; the risk is as much as seven times higher for younger drinkers. Furthermore, individuals endorsing HID are more likely to meet criteria for a moderate or severe AUD diagnosis as compared to binge-only drinkers, who are more likely to meet criteria for a mild AUD diagnosis (Linden-Carmichael, Vasilenko, et al., 2017). As the conceptualization of AUD transitions to a spectrum perspective, there is utility in understanding drinking behavior from a similar vantage point.

Demographic Characteristics Associated with HID

Sex Differences. There is substantial evidence that sex is meaningfully related to drinking risk, engagement, and consequences. Men drink at higher rates, in higher quantities, and experience more alcohol-related problems as compared to women (Nolen-Hoeksema, 2004; Wilsnack, Vogeltanz, Wilsnack, & Harris, 2000). Additionally, AUD has a notably higher prevalence in adult men than women for both past year (17.6% vs. 10.4%) and lifetime (36.0% vs. 22.7%) diagnoses (Grant et al., 2015), although women are at higher risk for alcohol-related physical illness at lower levels of exposure (Nolen-Hoeksema, 2004). In line with this, men engage in heavy drinking behavior more frequently and in more extreme forms than do women (Naimi et al., 2010; Terry-McElrath & Patrick, 2016). Naimi and colleagues (2010) found that 42.5% of men consumed 8 or more drinks during their most recent binge, whereas 25.7% of female

binge drinkers consumed at this level (Naimi et al., 2010). While the HID thresholds were not utilized, the 8-drink query demonstrated that roughly a quarter of women reporting recent binge drinking engage in HID (Naimi et al., 2010), placing a substantial portion of this sample at elevated risk for severe drinking-related consequences. This also highlights the need for empirical attention to sex differences in HID with sex-specific consumption thresholds, and to the mechanisms underlying this apparent difference (Hingson et al., 2017). Given the differential rates of alcohol use, divergent risks, and high potential for severe consequences associated with HID, it is important to examine sex differences associated with this behavior so as to obtain a more accurate understanding of sex-specific risks and consequences of HID.

Age. Age is associated with drinking behavior, such that initiation occurs during adolescence and young adulthood, often in the form of heavy episodic/high-risk drinking, with a subsequent plateau and decline during adulthood (NIAAA, 2008; Patrick, Terry-McElrath, et al., 2016); heavy drinking becomes increasingly non-normative as individuals age out of young adulthood (NIAAA, 2008). This indicates unique processes underlying heavy drinking in older age groups (Naimi et al., 2010; Patrick et al., 2017; Patrick & Terry-McElrath, 2017). In fact, recent research has shown that motives to drink among high-intensity drinkers change, develop, and vary throughout the transition from high school to young adulthood (i.e., ages 18-26). Where drinking because of anger and to have a good time are salient motives for high intensity drinkers in their late teens and early 20s, boredom is a stronger correlate with HID among individuals in their mid-20s (Patrick et al., 2017). It stands to reason that motives may further develop as drinkers

move into their 30s, and that HID in this later developmental stage is driven by mechanisms divergent from those in young adulthood.

While much research on heavy alcohol use focuses on college students and young adults (Patrick, Crouce, et al., 2016; Patrick & Terry-McElrath, 2017; Patrick, Terry-McElrath, et al., 2016; White et al., 2006) and there is evidence that individuals aged 21-25 are at highest risk for HID (Hingson et al., 2017), it is becoming increasingly clear that a significant portion of adults beyond this age range engage in HID with frequency. Data from the National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III; Grant, Chu, & Sigman, 2014) indicated that the mean age of individuals reporting past year HID is approximately 34 (Linden-Carmichael, Lanza, Dziak, & Bray, 2017) and that 19% of US adults in this mean age range of 31-35 engaged in past year HID, with 11% reporting consuming at the lower HID threshold and 8% reporting consuming at the higher HID threshold (Hingson et al., 2017). Furthermore, the number of adults in this age range engaging in HID significantly increased between NESARC waves I (2001-2002) and III (2012-2013). This increase was also observed in older age groups, accompanied by a complementary decrease in the proportion of adults whose alcohol consumption never reached the binge threshold (Hinson et al., 2017).

Socioeconomic Factors. Educational attainment is associated with alcohol use, in that college attendance is a proximal risk factor for heavy drinking (Slutske, 2005), but educational attainment is a long-term protective factor for alcohol related problems (Jones, Bates, McCoy, & Bellis, 2015). Individuals with lower educational attainment are at higher risk for HID in adulthood (Hingson et al., 2017); however, some findings have shown that heavy drinking is less prevalent in less educated groups, but that those who do

drink heavily do so at a higher frequency and quantity than drinkers with a higher level of educational attainment (Kanny et al., 2013). Similarly, some studies have found that high SES individuals engage in substance use at higher rates than low SES individuals, but with a gradation effect: both high and low SES individuals drink at rates exceeding the “low risk limit” recommended by health authorities (i.e., 8/12 standard drinks per week for women/men), although low SES individuals are more likely to do so at extreme levels (Lewer, Meier, Beard, Boniface, & Kaner, 2016). Thus, while both groups may be engaging in what would be labeled as “binge drinking,” low SES individuals drink at a rate that could be classified as “high intensity.” This demonstrates the importance of examining heavy drinking rates more closely, as there are differences occurring between groups at higher quantities of alcohol engagement that are overlooked when examining heavy drinking as a singular entity.

Big Five Personality Traits and Alcohol Use

Much research has been dedicated to understanding the impact of personality characteristics on drinking risk, engagement, and outcome (e.g., Kotov, Gamez, Schmidt, & Watson, 2010; Malouff, Thorsteinsson, Rooke, & Schutte, 2007). Findings show that low agreeableness and conscientiousness are associated with quantity and frequency of drinks and drinking episodes, binge drinking, having a diagnosis of AUD, and other facets of drinking behavior (Few et al., 2014; Malouff et al., 2007). Neuroticism (Malouff et al., 2007) and extraversion (Raynor & Levine, 2009) have also been implicated in alcohol use, although these patterns are less established and appear to be differentially impactful across men and women (Martin & Sher, 1994). Similarly, low constraint (i.e., being cautious, avoiding risk; comparable to conscientiousness) and high negative

emotionality (i.e., being reactive to stress, aggressive; comparable to neuroticism) during adolescence are associated with the development of AUD (Elkins, King, McGue, & Iacono, 2006). However, there is, to date, no research on the differential associations of these traits on binge drinking versus HID. While past research has shown that these traits are associated with drinking quantity (Malouff et al., 2007), these findings lack the specificity to accurately delineate between bingeing and HID. It is plausible that the relationship between personality and drinking is a linear, dose-response type effect, such that higher neuroticism, lower agreeableness, and lower conscientiousness are associated with increasing levels of drinking as polarities of the traits become more extreme.

Childhood and Developmental Factors Associated with Alcohol Use

Family History of Alcohol Problems. Numerous factors, many of which likely or necessarily predate alcohol use initiation, are associated with heavy drinking during adolescence and beyond. Family history of alcohol problems and alcoholism are substantial risk factors for experiencing alcohol related harms (Schuckit & Smith, 2000), with an estimated 50-70% of risk for AUD being attributable to additive genetic factors (Agrawal & Lynskey, 2008), and it appears as though there may be specific genetic associations with binge drinking (Treutlein et al., 2006; Vaughn, Beaver, DeLisi, Howard, & Perron, 2009). However, it is unclear how these childhood and familial factors may influence HID and discrete levels of alcohol use beyond the binge threshold in adulthood. While extreme levels of alcohol consumption are indeed associated with AUD (Hingson et al., 2017), it is important to not conflate these drinking outcomes, but rather understand how familial influences can contribute to risky behavior in addition to (or in the absence of) a diagnostic presentation.

Childhood Externalizing Disorders and Age of First Drink. Other, at least partially heritable, conditions that present during childhood, such as conduct disorder and attention deficit/hyperactivity disorder (ADHD), are also risk factors for AUD (Chartier, Hesselbrock, & Hesselbrock, 2010). Not only do these factors increase risk for alcohol use in adolescence (Deas & Brown, 2006; Whalen, Jamner, Henker, Delfino, & Lozano, 2002), which itself increases risk for alcohol related problems into adulthood (McCambridge, McAlaney, & Rowe, 2011), but also predict early initiation of alcohol use (Elkins, McGue, & Iacono, 2007), another factor that has historically been associated with alcohol problems in adulthood (DeWit, Adlaf, Offord, & Ogborne, 2000; Grant & Dawson, 1997), although more recent literature has called the validity of age of first drink as a predictor of later alcohol problems into question (Kuntsche, Rossow, Engels, & Kuntsche, 2016; Maimaris & McCambridge, 2014). Interestingly, while rates of ADHD and conduct disorder are much higher among boys than girls (Faraone, Sergeant, Gillberg, & Biederman, 2003; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004), there does not appear to be a sex by externalizing disorder interaction in examining alcohol related outcomes in adolescents (Elkins et al., 2007). Less is known about how these developmental factors impact HID in adulthood, but earlier age of alcohol use initiation has been found to increase risk for HID specifically at ages 25-26 (Terry-McElrath & Patrick, 2016) despite questions about this factor's validity as a predictor of alcohol related outcomes. It may be the case that these types of childhood risk factors, including family history of alcohol problems, age of first drink, and externalizing disorders have unique relationships with discrete levels of alcohol consumption into adulthood.

Peer and Coworker Drinking

Peer norms and perceptions of peer use contribute substantially to drinking behavior during younger developmental phases at which drinking initiation occurs (Connell, Gilreath, Aklin, & Brex, 2010; D'Amico & McCarthy, 2006), and peer alcohol use is one of the strongest predictors of adolescent alcohol use (Chartier et al., 2010; Connor, Haber, & Hall, 2016). Less is known about the influence of peers on adult drinking behavior. Research on peer influence on alcohol use exists almost exclusively in adolescents and young adults (e.g., Leung, Toumbourou, & Hemphill, 2014) and relational models of alcohol use in adults focus more on romantic and spousal relationships. These studies generally find that romantic and spousal relationships are protective against alcohol use (Lee, Chassin, & MacKinnon, 2015; Rauer et al., 2016), unless the spouse has AUD, in which case risk for AUD is increased (Kendler, Lönn, Salvatore, Sundquist, & Sundquist, 2016). Sex differences in heavy drinking risk have also been found among older adults, such that marriage and remarriage are protective for men while remarriage increases risk of heavy drinking among women (Reczek, Pudrovska, Carr, Thomeer, & Umberson, 2016). Taken together with findings that individual drinking patterns often align with social groups, it may be expected that individuals who engage in HID in adulthood report a higher proportion of peers and coworkers who engage in heavy drinking behavior and that there may be sex-specific peer group effects.

Present Study and Hypotheses

The study at hand sought to replicate the empirical differentiation of HID categories from binge drinking via corroboration with past year drinking behavior,

examine individual demographic risk factors for HID, explore potential associations between personality traits and HID, identify familial and childhood characteristics that may provide utility in predicting adult HID, probe the relationship between perceived peer alcohol use and HID, and examine alcohol-related consequences across discrete levels of alcohol consumption. Sex differences in these factors were also a focus, as alcohol use shows distinct patterns across men and women, thereby indicating potentially distinct mechanisms of risk.

It was hypothesized that HID drinkers would report higher frequency and quantity of past year drinking measures than binge drinkers, and that these measures would further differentiate the two levels of HID. Males, younger individuals, less educated individuals, and never married individuals were expected to be at higher risk for HID. High neuroticism, low agreeableness, and low conscientiousness were expected to increase risk for HID, such that individuals endorsing these characteristics at more extreme levels would be more likely to be in the HID categories. Childhood externalizing disorders, most notably conduct disorder, were expected to be associated with HID. Perceived proportion of peers and coworkers who drink heavily was expected to increase linearly with drinking level. Rates of alcohol-related consequences were also expected to linearly increase with drinking level. With respect to sex differences, it was hypothesized that men would endorse higher frequency of drinking behaviors and higher typical quantities per drinking episode; men were also expected to be overrepresented in the HID drinking categories. Interactions of sex were expected with neuroticism, agreeableness, and conscientiousness in predicting drinking category outcome. Sex differences analyses for

family history of alcohol problems, peer use, passing out and blacking out in the context of HID were exploratory, as there is little precedent in the literature.

Methods

Participants

Participants were 2,986 twins and 416 non-twin siblings drawn from a sample of 3,738 individuals from the Australian Twin Registry Cohort III (for more information about participants, see Lynskey et al., 2012). The final sample consisted of 3,402 Australian adults reporting past year drinking; the 336 respondents (8.9% of all respondents) reporting no past year drinking were excluded from analyses. Table 1 displays the analytic sample characteristics. Mean age was 32 (range=22-46) and 97% of the sample was over age 28, representing a unique age group in heavy drinking research. Fifty-three percent of the sample was married, 41% were single or never married, and 5% were separated, divorced, or widowed. Twenty four percent attained a high school education or less, 28% completed technical school, 28% completed undergraduate studies, and 20% completed graduate school. A majority were employed full time (63%) or part time (15%). Approximately 2% of the sample reported Aboriginal descent via at least one biological grandparent, and 94% were of British descent; these characteristics were unassociated with past year drinking and will not be examined further.

Procedure

Participants were surveyed by computer-assisted telephone interview (CATI) in 2005–2009 (participation rate=76%; Lynskey et al., 2012), and were subsequently invited to complete

a self-report questionnaire, either online (75%) or by postage-paid mailed paper-and-pencil (25%). The response rates for the questionnaire were excellent: 93% of those interviewed completed the questionnaires, usually within two weeks of the interview.

Measures

Alcohol use. Assessment of alcohol use was based on the Australian version of the Semi-Structured Assessment of the Genetics of Alcoholism (SSAGA-OZ; Bucholz et al., 1994; Heath et al., 1997) and administered via CATI. For this study, we focused on past year reports of frequency of drinking, frequency of being drunk, frequency of binge drinking, typical quantity of drinks per drinking episode, and maximum number of drinks consumed in a single 24-hour period. Response options for frequency measures included 10 options ranging from “every day” to “never.” Typical quantity response options included 10 items ranging from 1-2 drinks to 31 or more drinks. Maximum number of drinks was reported as a self-generated numerical response. These past year measures were included in part to corroborate a pattern of alcohol use across drinking thresholds, which were created based upon the maximum number of drinks variable (described below; see Table 2).

High Intensity Drinking. High intensity drinking (HID) was derived from the maximum drinks in the past year item (Hingson et al., 2017). Drinking level was created as a four-level ordinal variable, according to the current thresholds: “non-binge” included individuals who reported that their maximum drinks did not exceed 3 (for women) or 4 (for men), “binge” included individuals reporting 4-7 (for women) or 5-9 (for men), “high intensity low” (HIL) included individuals reporting 8-11 (for women) or 10-14 (for

men), and “high intensity high” (HIH) included individuals who reported 12 or more (for women) or 15 or more (for men).

Drinking Related Consequences. Participants were queried about experiencing alcohol-related blackout (i.e., “drinking enough so that you could not remember things you had said or done”) and passing out (i.e., “falling asleep from drinking too much”). The focus of the current study was the occurrence of blackout and passing out in the past year, which was based on reports of recency of last blackout and/or passing out experience. The SSAGA-OZ assessed the DSM-IV criteria for alcohol abuse and dependence, which were scored according to the DSM-5 criteria for AUD, absent the criterion of craving, which was not included in the DSM-IV and was therefore not queried; it is unlikely that the omission of the craving criterion substantially impacted the prevalence of DSM-5 AUD in this sample (Agrawal, Heath, & Lynskey, 2011; Casey, Adamson, Shevlin, & McKinney, 2012). Individuals with 2 or more symptoms were considered to have an AUD diagnosis by these approximate DSM-5 criteria. The focus of the current study was past year diagnosis, which were based on reports of recency for each of the qualifying symptoms.

Personality. Big Five personality traits were assessed using an adapted NEO PI-R (Costa & McCrae, 1992a, 1992b; Few et al., 2014). The scale consisted of 74 items scored on a 1 (strongly disagree) to 5 (strongly agree) scale. Domain scores were generated by computing the means for each subscale, which were subsequently standardized via z-transformation for analysis, such that $M=0$ and $SD=1$. Alphas for neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness were .89, .85, .77, .81, and .85, respectively.

Family History of Alcohol Problems. The SSAGA-OZ assessed the presence of alcohol-related problems and for various family members, including father, mother, twin, and current partner. Respondents were asked “did drinking ever cause any of the following people to have problems with health, family, job or police, or any other problems?” This query was followed with a list of familial relations, to which respondents endorsed “yes” or “no” for each member.

Childhood Externalizing Disorder Diagnosis. The SSAGA-OZ assessed the DSM-IV criteria for Conduct Disorder and Attention Deficit Hyperactivity Disorder (ADHD). Separate analyses were run for each ADHD subtype (i.e., combined, predominantly inattentive, and predominantly hyperactive/impulsive).

Peer and Coworker Alcohol Use. Participants were queried regarding their perceptions of the proportion of their current male friends, female friends, and coworkers that gets drunk at least one time per month (“how many of your male friends/female friends/the employees at your current or most recent job get/got drunk at least once a month?”). Responses were on a 1-100 percentile scale.

Analytic Plan

Analyses were conducted using survey data analysis procedures in SAS software version 9.4 (PROC SURVEYMEANS, PROC SURVEYFREQ, and PROC SURVEYLOGISTIC; SAS Institute, 2015) that took the non-independence of twin pair observations into account. Multinomial logistic regression analyses and chi square cross tabulation were used to conduct comparisons of drinking categories within the full sample and across men and women on past year drinking behavior, demographic

characteristics, personality scales, family history of alcohol problems, childhood behavioral factors, peer drinking, and drinking-related consequences.

The analyses were conducted in four stages. First, using multinomial logistic regression, separate exploratory models were run for each individual correlate to probe potentially differential associations with each level of past year drinking. Second, sex was added into the model as a covariate to determine if effects remained after controlling for this factor. Third, interactions of sex with each correlate were added to each model. Fourth, tests yielding significant interactions were probed further via separate within- and across-sex analyses.

Step four of these analyses was approached in one of two ways. For dichotomous correlates (e.g., family history of alcohol problems, childhood externalizing disorder diagnosis, alcohol-related problems), chi-square tests were conducted to examine within-sex prevalence differences across drinking category to determine if prevalence varied as a function of alcohol use, and to compare rates across sex within each drinking category to determine if men and women within each drinking group differed on each correlate. For continuous correlates (e.g., past year drinking behaviors, personality variables, age of first drink,) these differences were modeled using logistic regression.

The analyses focused primarily on differences between binge, HIL, and HIH drinking categories, as these comparisons are most relevant for testing the hypothesis that HID is quantifiably distinct from binge drinking. With few exceptions, comparisons involving the non-binge group are presented in tables but will not be explicitly discussed.

Results

Alcohol Use and Prevalence of HID

Past year HID was unexpectedly prevalent in this sample: 23.60% (N=803) reported non-binge consumption, 32.63% (N=1110) reported binge-only consumption, 21.69% (N=738) reported HIL, and 22.08% (N=751) reported HIH (see Table 1). These rates are notably higher than those found in recent national US samples (Hingson et al., 2017). Comparison of drinking categories substantiated the hypothesis that past year drinking behavior (i.e., drinking frequency, drink frequency, binge frequency, and typical quantity per drinking episode) would differ by drinking level (see Table 2; see Table S2 for odds ratios), thereby supporting the use of a measure extracted from a single episode of maximum drinks in the past year as an indicator of HID and its two distinct levels. HIH drinkers, on average, consumed alcohol on roughly 40% of days (i.e., about 3 days per week) and typically consumed, on average, roughly 4.5 drinks. Interestingly, the typical quantity per drinking occasion in men and women in the HIH group reflected the binge threshold: on average, HIH drinkers consumed at their respective gender adjusted binge thresholds on a typical drinking occasion (see Figure 1). HIL drinkers, on average, consumed alcohol on roughly 30% of days (i.e., about 2 days per week) and typically consumed, on average, 3.5 drinks. Binge-only drinkers, on average, consumed alcohol on roughly 20% of days (i.e., about 1.5 days per week) and typically consumed, on average, 2.5 drinks. Non-binge drinkers, on average, drank on roughly 9% of days (less than one day per week) and typically consumed, on average, about 1.5 drinks. Put simply, individuals reporting meeting or exceeding three times the binge threshold at least once

in the drank roughly twice as often and consumed roughly twice as much on a typical drinking occasion as compared to those who report binge-only past year drinking.

Sex Differences. Means for past year drinking behavior in men and women are presented in Table 2. Each of these measures linearly increased with each successive drinking category in both men and women. Men in the binge, HIL, and HIH categories generally reported higher frequencies of past year drinking behaviors than did women, with notable divergence emerging in the HIL and HIH categories. There was a significant interaction between typical quantity and sex, $\chi^2=10.58$, $df=3$, $p <.0001$, driven by women (versus men) evidencing more steeply accelerating odds of being in binge (OR=3.03 versus 2.06), HIL (OR=4.07 versus 2.64), and HIH (OR=4.56 versus 3.17) drinking categories as compared to non-binge than did men with each unit (i.e., standard drink) increase in typical quantity per drinking occasion. However, odds were comparable across women and men for being in HIL (OR=1.35 versus 1.28, respectively) and HIH (OR=1.51 versus 1.54, respectively) compared to binge, and HIH compared to HIL (OR=1.12 versus 1.20, respectively), thereby not supporting typical quantity as a strong differentiator of binge versus HID.

Demographic Characteristics

Demographic characteristics are presented in Table 1 (see Table S1 for odds ratios). A higher proportion of women than men reported non-binge, $\chi^2=289.99$, $df=1$, $p <.0001$, and binge consumption, $\chi^2=166.36$, $df=1$, $p <.0001$, whereas men reported higher rates of HIH, $\chi^2=39.53$, $df=1$, $p <.0001$; rates of HIL were comparable across men and women, $\chi^2=0.49$, $df=1$, $p=.48$ (see Figure 2). Sex was significantly associated with drinking category, $F(3, 2262)=108.42$, $p <.0001$, such that men had higher odds of being

in each successively heavier drinking category compared to each lower drinking level. Odds for HIL (OR=2.28 95% CI [1.88, 2.77], $p < .0001$) and HIH (OR=3.96, 95% CI [3.23, 4.84], $p < .0001$) were elevated as compared to binge drinking for men versus women, as were odds for HIH as compared to HIL (OR=1.74, 95% CI [1.41, 2.14], $p < .0001$).

Age was associated with drinking category, $F(3, 2262)=15.07$, $p < .0001$, such that being older decreased odds of HIH compared to binge. Age remained significant after controlling for sex, $\chi^2=53.70$, $df=3$, $p < .0001$, and showed a protective effect against HIL versus binge, as well as for HIH versus HIL, such that older age decreased odds of being in the higher drinking category (see Table S1). The age by sex interaction was not significant, $\chi^2=2.57$, $df=3$, $p=.46$.

Educational attainment was differentially associated with drinking level, $F(3, 2262)=16.34$, $p < .0001$, demonstrating a protective effect against HIH compared to both binge and HIL. Educational attainment predicted drinking category after controlling for sex, $\chi^2=34.54$, $df=3$, $p < .0001$, although some effects, including decreased odds of HIH versus binge, were rendered nonsignificant (see Table S1). The education by sex interaction was not significant, $\chi^2=5.47$, $df=3$, $p=.14$.

Marital status was also differentially associated with drinking level, $F(3, 2191)=26.40$, $p < .0001$, with never married individuals being at higher risk than individuals who were married or in defacto relationships for HIL and HIH as compared to binge, but with no differentiation between HIL and HIH (see Table S1). Married/defacto individuals constituted a significantly higher proportion of the binge group, $\chi^2=38.07$, $df=1$, $p < .0001$, whereas never married individuals constituted a significantly higher

proportion of the HIH group, $\chi^2=12.22$, $df=1$, $p=.0005$; a marginally, but not significantly, higher proportion of the HIL group was never married, $\chi^2=3.13$, $df=1$, $p=.076$. Marital status remained significant after controlling for sex, $\chi^2=20.19$, $df=3$, $p<.0001$, and there was a significant interaction between marital status and sex, $\chi^2=20.19$, $df=1$, $p=.0002$. Examination of drinking level within sex found that, among men, a significantly higher proportion of binge drinkers were partnered, $\chi^2=8.22$, $df=1$, $p=.004$, and a marginal majority of the HIH group was never married, $\chi^2=3.01$, $df=1$, $p=.08$; there was no difference in marital status within the male HIL group ($p=.53$). Among women, a higher proportion of binge group was partnered, $\chi^2=30.86$, $df=1$, $p<.0001$, while a higher proportion of the HIL, $\chi^2=9.76$, $df=1$, $p=.002$, and HIH, $\chi^2=12.34$, $df=1$, $p=.0004$, groups were never married. Examination of sex differences within drinking level found that a higher proportion of women were never married as compared to men in the HIL group, $\chi^2=7.08$, $df=1$, $p=.008$; this pattern trended toward significance among HIH drinkers, $\chi^2=3.07$, $df=1$, $p=.08$. Marital status rates did not differ across men and women in the binge group, $\chi^2=0.56$, $df=1$, $p=.45$.

Personality Traits

Results of personality associations and group mean differences are presented in Table 3. Examinations of loess regressions and mean distributions of each trait by drinking category and sex demonstrated that all traits evidenced a reasonably linear relationship with drinking or a zero slope (i.e., no relationship), with the exception of openness to experience. Because it is unclear if this exception was due to measurement error or true nonlinearity, openness to experience was analyzed both before and after log transformation.

Neuroticism scores did not differ across drinking category; extraversion significantly differentiated across drinking groups, increasing odds of HIH as compared to binge; openness to experience showed no effects before or after transformation; agreeableness significantly and linearly decreased risk across all groups; conscientiousness showed a similar pattern, but did not significantly differ between HIL and HIH categories. All significant associations remained after controlling for sex except for agreeableness for odds of HIH versus HIL (see Table S3 for odds ratios). Additionally, neuroticism became significant after controlling for sex, $F(3, 2145)=13.10$, $p=.004$, driven by an increase in risk of HIL and HIH versus non-binge, and HIH versus binge (see Table S3).

Sex Differences. Marginally significant sex interactions emerged for openness to experience, $\chi^2=7.72$, $df=3$, $p=.05$, and conscientiousness, $\chi^2=20.19$, $df=3$, $p=.05$. Below average openness to experience increased risk for HIL (OR=1.21, 95% CI [1.04-1.41], $p=.02$) and HIH (OR=1.23, 95% CI [1.05-1.43], $p=.01$) as compared to binge in men only; this effect did not remain after log transformation. Low conscientiousness increased risk for HIL (OR=1.22, 95% CI [1.08-1.38], $p=.001$) and HIH as compared to binge (OR=1.24, 95% CI [1.07-1.43], $p=.004$) in women only. No interactions emerged for neuroticism, extraversion, or agreeableness ($p=.14-.82$).

Family History of Alcohol Use

Associations of HID with family history of alcohol problems are presented in Table 4 (see Table S4 for odds ratios). Significant effects emerged for endorsing twin and current partner, but not father or mother experience of alcohol related problems. Drinking group comparisons showed that a twin and current partner experiencing alcohol problems

increased risk of HIH as compared to both binge and HIL. After controlling for sex, significance for all effects were unchanged except for father's experience of alcohol problems, which became significant, $\chi^2=9.29$, $df=3$, $p=.03$, driven by increased odds of being in HIH versus non-binge (OR=1.09, 95% CI [1.01-1.18], $p=.02$; see Table S4). This suppression effect appeared to be driven by opposing patterns of reporting across men and women, with the percentage of men reporting father's history of alcohol problems increasing linearly with drinking category, and women reporting a peak prevalence in the binge category with a linear decrease across each successive drinking category.

Sex Differences. No significant interactions between sex and family history of alcohol problems in predicting drinking category. Thus, sex differences were not examined further.

Childhood Externalizing Disorders

Results for childhood factors associated with drinking are presented in Table 5. Age of first drink was linearly associated with drinking category in a descending pattern, such that average age of first drink was significantly lower in each successive category, indicating that, on average, higher intensity past year drinkers began drinking at a younger age. There were significant prevalence differences of combined and hyperactive subtypes of ADHD and conduct disorder across drinking groups. A diagnosis of ADHD, combined type increased risk of HIH as compared to binge, with no distinction between HIL and HIH; ADHD, hyperactive type increased risk of HIH as compared to binge but did not differentiate odds of HIL versus HIH. Conduct disorder increased risk of HIH

relative to all other drinking categories. These effects remained significant after controlling for sex (see Table S5 for odds ratios).

Sex Differences. No significant sex interactions emerged for age of first drink ($p=.60$) or childhood externalizing disorders ($p=.29-.58$) in predicting drinking category membership, which aligns with research examining externalizing disorders and alcohol use in adolescents (Elkins et al., 2007). However, it is of note that the prevalence of ADHD combined and hyperactive/impulsive subtypes differed as a function of drinking category for women, but not men (see Table 5).

Perceived Peer Drinking

Associations of HID with perceived peer drinking behavior are presented in Table 6 (see Table S6 for odds ratios). Consistent with the extant literature on perceptions of use in peers (Connell et al., 2010), individuals who reported that higher proportions of their current friends and coworkers get drunk at least once per month were more likely to be in a higher drinking category, such that there was a significant linear increase in the reported number of peers getting drunk at least once per month with each successive drinking category. These effects remained after controlling for sex.

Sex Differences. There was a significant interaction of sex with perceived number of male friends who get drunk at least once per month, $\chi^2=33.61$, $df=1$, $p<.0001$. While there was a main effect of this variable in both men and women (see Table 6), men (versus women) were at higher odds for being in HIH as compared to binge (OR=23.15 versus 5.43) and HIL (OR=4.87 versus 1.82) with an increase in perceived number of male friends who get drunk at least once per month. Notably, there was no interaction between sex and perception of female friends who get drunk at least once per month

($p=.21$). While the perception of number of female friends who get drunk is influential in drinking behavior as a main effect, it appears as though the impact of perception of male friend behavior is uniquely influential in heavy drinking behavior among men.

Drinking-Related Consequences

Prevalence of drinking-related consequences by drinking category are presented in Table 7. Rate and odds of past year blackout, passing out, and AUD increased significantly with each successive drinking category; all effects remained after controlling for sex (see Table S7 for odds ratios). Binge-only drinkers reported these consequences at relatively low rates, with roughly three percent reporting blackout and/or passing out in the past year. Blackout was over five times as prevalent in HIL drinkers, and over 10 times as prevalent in HIH drinkers compared to binge-only drinkers. Similarly, passing out was four times as prevalent among HIL drinkers, and over six times as prevalent among HIH drinkers compared to binge-only drinkers. Roughly 2% of binge-only drinkers met criteria for a past year AUD of any severity (i.e., endorsed at least two criteria), compared to over 12% of HIL and almost 29% of HIH drinkers. On average, binge-only drinkers endorsed 0.17 symptoms, HIL drinkers endorsed 0.57, and HIH drinkers endorsed 1.21; among those meeting past year disorder criteria, binge-only drinkers endorsed, on average, 2.88 symptoms, HIL drinkers endorsed 2.74, and HIH drinkers endorsed 3.38.

Sex Differences. There was a significant interaction between past year AUD and sex, $\chi^2=14.68$, $df=2$, $p=.0006$, but not black out or passing out ($ps=.19$, $.61$, respectively). Past year AUD increased odds of HIL and HIH as compared to binge, and HIH compared to HIL in both men and women; however, odds for HIH compared to HIL were

substantially accelerated in men as compared to women (see Table S7). As AUD is a low base rate occurrence, there is little utility in examining the within-sex prevalence of AUD within each drinking group: individuals with AUD are a minority in all drinking groups, but this is wholly unsurprising and provides little new information. In examining men versus women with AUD within each drinking category, men accounted for significantly more of the AUD diagnoses in the HIH group, $\chi^2=45.29$, $df=1$, $p<.0001$.

Discussion

The present study supports previous findings that levels of past year drinking can be empirically differentiated, as corroborated by other aspects of past year drinking behavior that quantitatively distinguish binge drinkers from high intensity drinkers. Furthermore, the two levels of HID were differentiated from each other by these metrics (i.e., HIL individuals were distinguishable from HIH individuals in terms of past year drinking behavior), demonstrating the construct validity of conceptualizing drinking in this manner and elucidating that more specified measures of HID are warranted. Further research could benefit from expanding methods of assessing HID: although the “past year maximum drinks” proxy has demonstrated utility in nascent HID research (Hingson et al., 2017) and is bolstered by corroborating patterns of past year drinking, the empirical support garnered for this construct suggests that more specialized, psychometrically sound assessment could benefit future investigations of HID. This is particularly important given that individuals drinking at this level are more likely to experience memory impairment and blackout, and therefore be less reliable reporters of their drinking behavior (Northcote & Livingston, 2011). This makes HID a prime candidate for naturalistic, biomarker, ecological momentary assessment, and field research as a

means of enhancing the validity of drinking quantity measures. Future investigations of this phenomenon may consider such approaches.

Rates of HID were notably higher in the present sample than in past examination of HID in the US (e.g., Hingson et al., 2017). While this may be associated with Australian cultural norms surrounding drinking- per capita alcohol consumption is higher in Australia than in the US, including during the time of data collection (WHO, 2011)- it may also be the case that past research has failed to capture the high rate at which adults, particularly men, engage in HID due to a historical lack of delineation between binge drinking and HID (White et al., 2006). Replicating past research (Hingson et al., 2017), sex demonstrated a robust effect on HID prevalence and risk, although examination of differential consequences of HID for men and women warrants further attention. While men may experience direct consequences of alcohol use (e.g., AUD) at a higher rate, women may be at elevated risk for a different set of more indirect consequences, such as sexual violence and victimization that is magnified when engaging in HID and/or being around people who do (Nolen-Hoeksema, 2004). Sex differences in HID consequences have yet to be pointedly examined (Hingson et al., 2017), and could be a valuable topic of consideration.

Lifestyle factors impacted by cultural and societal norms, as well as age and developmental considerations relevant to a mid-adult sample, may in part influence differences in heavy drinking across men and women. Primary responsibility of household and childcare may play a role in depressed rates of HID among women (Laborde & Mair, 2012); women not uncommonly serve as homemakers, as was the case in the present sample (98% of homemakers were women), and take on the primary role in

childcare and associated responsibilities. Alcohol use is often stigmatized and viewed as negligent in the context of these activities (Lyons & Willott, 2008), is actively targeted in public health efforts (e.g., drinking while pregnant and/or breastfeeding), and/or reduces time available to drink, be intoxicated, and recover from a drinking episode. These factors may influence women's decision of whether or not to consume alcohol, while men are necessarily precluded from having to consider them when making decisions about alcohol use. In the present sample, a roughly 15% HID rate increase was observed in men without children compared to those with, while rates of HID were almost double among women without children compared to those with; this indicates a potentially differential impact of parenthood across men and women. This could be due to divergent social role expectations of men and women in this age group, the contraindication of drinking with biological processes of childbearing, and/or the issues of alcohol use in the context of childrearing described above. This dynamic is unique to examining HID in an adult sample, as issues of parenthood are not as salient in the college-aged and young adult samples typical of heavy drinking studies. Thus, the gender polarity of HID may be magnified, albeit far from fully accounted for, when examining heavy drinking an adult sample. More focused studies on HID in this age group could help clarify this effect.

Personality traits emerged with mixed findings. Neuroticism and conscientiousness differentiated HID drinkers from binge drinkers, but there were no personality differences between the two levels of HID. This may indicate that certain personality characteristics differentiate binge drinkers from high intensity drinkers in general, but without a dose-response effect that increases substantially beyond the HIL threshold. Mirroring previous examinations of personality and drinking (Raynor &

Levine, 2009), extraversion emerged as a risk factor for engaging in HID as compared to non-binge consumption, but did not differentiate HID from binge drinking. Social motives to drink could be at play here, as extraversion has been found to be associated with social motives (Stewart & Devine, 2000), but there is a dearth of research regarding motives to consume alcohol among high intensity drinkers in middle adulthood (Patrick et al., 2017). The four factor model of alcohol use (Cooper, 1994) specifically addresses social motives to consume alcohol, which may provide further insight into the mechanistic processes of extraversion and other personality traits among heavy alcohol consumption in adults. This could be a promising avenue to pursue, as research has also found associations between neuroticism and coping motives, which are associated with heavy drinking and therefore particularly relevant to HID (Kuntsche, Knibbe, Gmel, & Engels, 2006; Stewart & Devine, 2000). Interestingly, openness to experience evidenced a potentially nonlinear association with alcohol use among men, such that the trait was highest in binge drinkers, lower in non-binge drinkers, and even lower in high intensity-drinkers, although the former difference was nonsignificant. There does not appear to be any extant research demonstrating a similar effect or providing a perspective from which to discern whether this is measurement error or true nonlinearity. Further research is needed to ascertain how openness to experience may be differentially associated with binge versus HID among male drinkers.

Results for family history of alcohol use indicated that the salience of parental influence on drinking behavior decreases over time, while the impact of contemporaries (i.e., twin and current partner), becomes more impactful on drinking behavior in adulthood. This points toward strong environmental and peer influences, a question that a

twin model approach could be well equipped to address. Interestingly, father's history of alcohol problems became a significant predictor of HIH versus non-binge drinking after controlling for sex, possibly indicating a unique impact of father's drinking behavior on their sons in light of the higher rates of paternal alcohol problems among men in the HID categories (see Table 5). This male-male social effect mirrors that found in the results for perception of peer drinking behavior, wherein the number of male friends perceived to get drunk at least once per month showed uniquely elevated risk among men. This aligns with traditional social norms of heavy alcohol use being a more masculine activity, and the notion that social norms are more accepting of males drinking heavily in social situations (Sudhinaraset, Wigglesworth, & Takeuchi, 2016); this could also contribute to the discrepant rates of HID across men and women observed in this sample.

Unsurprisingly, younger age of first drink was linearly associated with each successive drinking category, replicating findings that younger alcohol use initiation is associated with later patterns of heavier and more problematic alcohol use (DeWit et al., 2000; Grant & Dawson, 1997). The impact of childhood ADHD on drinking appeared to be driven by hyperactive symptoms, as the purely inattentive subtype evidenced no associations with drinking behavior; the latter finding stands in contrast with past studies on ADHD subtypes and alcohol use through adolescence and adulthood (Molina & Pelham Jr, 2003). In line with previous research, conduct disorder was also associated with heavier drinking (Glantz et al., 2009; Nock, Kazdin, Hiripi, & Kessler, 2006). While it may be considered that these diagnoses are more common among boys, the effects of these diagnoses remained even after controlling for sex and no interactions emerged. Thus, this symptom presentation in childhood may be indicative of heavy drinking well

into adulthood. It may also be the case that the physiologically depressing effects of alcohol are sought out as a method of self-regulation for assuaging hyperactive symptoms. This is notable given that low doses of alcohol provide a stimulant effect while the sedating effects of alcohol occur at higher doses (Pohorecky, 1977), plausibly serving to reinforce high doses of alcohol as a mechanism for self-regulation or mitigation of hyperactivity.

The association of peer use with drinking behavior in the present sample indicates that the influence of perception of peer use on drinking behavior persists beyond adolescence and into adulthood. While this factor is highlighted in the adolescent literature due to its robust association with substance use risk in youth (Connell et al., 2010), it appears as though peers play a notable role in adult heavy drinking, as well. Recent research on young adult veterans ages 18-34 found similar patterns, noting that this population substantially overestimated their peers' alcohol consumption and that this overestimation was associated with heavy episodic drinking (Pedersen, Marshall, Schell, & Neighbors, 2016). However, in examining adult samples of heavy drinkers, the directionality of the relationship between alcohol use and perception of peer use becomes increasingly blurred: it is unclear if heavier drinkers are influenced by their inflated perceptions of their peers' drinking, if they have self-selected a heavier drinking group of friends that more closely aligns with their own established drinking patterns, or both. While this question is difficult to disentangle without data on the actual use of respondents' peers, the distinction between friends and coworkers permit some inference into this issue. Friends are typically self-selected while coworkers are not, creating a distinction between these groups that can indirectly address the issue of peer self-

selection. While perception of both friend and coworker drinking behavior was associated with drinking, friends appeared substantially more influential (see Table S6). This may point to self-selection of friends with similar drinking habits, although it may also be the case the friends are more influential by virtue of the more intimate nature of the relationship as compared to coworkers. Clearly, there is more to learn with respect to peer influence on adult heavy drinking, and this could be a promising avenue to explore for harm reduction and educational interventions for adults (Pedersen et al., 2016).

The rates of the three drinking-related consequences presented here highlight both the importance of differentiating drinkers who do not consume at the binge threshold from those who do, as the proximal physiological consequences of alcohol only begin to appear substantially at the HID level. However, further examining these consequences in the context of increasing levels of alcohol consumption highlights the differential impact of these consequences among different types of drinkers. A point of contention brought to light by Wechsler and Nelson (2006) regarding the utility of further demarcating drinking levels was a lack of information regarding differential consequences of such behaviors. As this study, amongst other research conducted on HID in the past decade since their review was published, highlights, binge-only drinkers comprise a small fraction of those experiencing alcohol-related consequences. The findings presented here support the contention made by White and colleagues (2006) that severe consequences are unlikely to occur at the 4/5 binge cutoff, and that prevention efforts tailored to heavier drinkers and highlighting the consequences they are more likely to experience may be beneficial. A major limitation of extant general prevention and intervention programming is that many drinkers, particularly those to drink at lower levels, have not experienced alcohol-related

consequences that motivate them to change their behavior. Given that binge-only drinkers appear to experience alcohol-related consequences at quite low rates, the attention that needs to be paid to higher acuity drinkers may be obscured by generalizing all heavy drinkers into a single category.

Limitations

This study presents with some notable limitations. While the maximum drinks item permits inference regarding engagement in HID, there is a lack of information regarding frequency of past year HID. While frequency of past year bingeing is reported and past year drinking behavior shows trends of higher frequency and quantity of consumption in higher-level drinking categories, this information cannot definitively provide information regarding the frequency of HID. Given that frequency of heavy drinking behavior is a steadfast predictor of alcohol related consequences (Wechsler et al., 2002), future research may specifically query frequency of engagement in HID. Similarly, there are a number of salient alcohol-related harms, such as hangover and driving under the influence, that are not included here but provide important information regarding consequences across the spectrum of HID.

Further, it must be acknowledged that personality changes and develops over time (Roberts, Walton, & Viechtbauer, 2006) and may therefore be an inconsistent reference point from which to examine drinking behavior, particularly in the context of individual factors that span from childhood to adulthood. Additionally, using both current/past year measures of personality and alcohol use at a single time point may lead to inaccurate estimates of personality traits, as engagement in heavy alcohol use at the time of

assessment can result in inflated trait estimates (Kotov et al., 2010). A longitudinal study with multiple time points of personality assessment may be a remedy to this issue.

It must also be noted that the large number of analyses presented here increases the likelihood of Type II error, and it may be necessary to approach results with p -values approaching .05 with skepticism. Despite this, the presented results provide initial evidence that regardless of HID frequency, engagement in this behavior is associated with notable individual characteristics and consequences.

Further understanding the differential characteristics of adult high intensity drinkers may aid in identifying individuals in this age group who are at risk for AUD, as middle adults are often not a focus of targeted public health efforts in this area. Because most adolescents and young adults “phase out” of this type of alcohol consumption, those who continue to engage in HID into their late 20s and 30s are perhaps more likely to be experiencing AUD and other alcohol-related harms associated with heavy, long-term use. Further, given that this age group comprises a substantial portion of the workforce, alcohol-related losses in terms of time and productivity may be a particularly salient issue when considering the impact of HID and its capacity to cause hangover and other alcohol-related harms that adversely impact day-to-day functioning. In addition, reaching an adult population for early intervention efforts presents its own unique considerations. Adolescents and young adults are often accessible through schools and community outreach, while older adults may be harder to access. Given the high rate with which adults are engaging in this high-risk drinking behavior, it is important to begin developing approaches to more effectively mitigate the harms of HID in this population;

understanding the factors that contribute to this drinking behavior may aid in development of optimally effective programming.

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Tables

Table 1
Sample Characteristics and Comparative Prevalence of Drinking Group Membership

	Full Sample (N=3402) % (95% CL)	Non-Binge (N=803) % (95% CL)	Binge (N=1110) % (95% CL)	HIL (N=738) % (95% CL)	HIH (N=751) % (95% CL)
Sex					
Women	62.07 (60.16-63.98)	82.81 (79.96-85.67)	70.63 (67.78-73.48)	51.36 (47.57-55.14)	37.82 (34.13-41.50)
Men	37.93 (36.02-39.84)	17.19 (14.33-20.04)	29.37 (26.52-32.22)	48.64 (44.86-52.43)	62.18 (58.50-65.87)
Marital Status					
Never married	41.43 (39.64-43.21)	26.65 (23.49-29.81)	38.14 (35.18- 41.10)	51.08 (47.38-54.79)	52.60 (48.84-56.35)
Married/defacto	53.28 (51.49-55.07)	69.16 (65.83-72.40)	56.81 (53.80-59.81)	44.58 (40.92-48.24)	39.68 (35.99-43.37)
Sep/Div/Wid	5.29 (4.54-6.05)	4.23 (2.80-5.67)	5.05 (3.79-6.32)	4.34 (2.82-5.85)	7.72 (5.81-9.63)
Education					
<High school	10.48 (9.36-11.58)	9.46 (7.41-11.52)	8.83 (7.13-10.53)	9.49 (7.29-11.68)	15.04 (12.36 -17.74)
High school	13.73 (12.50-14.97)	10.83 (8.62-13.04)	13.69 (11.58-15.81)	14.22 (11.64-16.81)	16.38 (13.71-19.04)
Technical college	28.05 (26.45-29.65)	26.77 (23.63-29.92)	25.50 (22.87-28.12)	29.81 (26.40-33.22)	31.42 (28.00-34.85)
Undergraduate	27.99 (26.39-29.60)	30.01 (26.73-33.30)	30.45 (27.70-33.20)	27.37 (24.08-30.66)	22.77 (19.66-25.88)
Postgraduate	19.76 (18.32-21.20)	22.91 (19.88-25.95)	21.53 (19.08-23.99)	19.11 (16.25-21.97)	14.38 (11.84-16.92)
Occupational Status					
Unemployed	2.38 (1.86-2.90)	2.12 (1.12-3.11)	3.06 (2.03-4.10)	2.57 (1.44-3.71)	1.46 (0.53-2.40)
Student	1.79 (1.34-2.24)	1.49 (0.66-2.33)	1.71 (0.91-2.51)	1.49 (0.62-2.37)	2.53 (1.41-3.65)
Casual	6.53 (5.67-7.38)	7.10 (5.32-8.87)	6.67 (5.17-8.16)	6.50 (4.73-8.28)	5.73 (4.07-7.38)
Part-time	15.00 (13.75-16.24)	21.54 (18.62-24.47)	18.74 (16.40-21.08)	9.62 (7.49-11.75)	7.86 (5.88-9.83)
Homemaker	10.61 (9.55-11.68)	22.67 (19.72- 25.610)	10.36 (8.54-12.18)	4.47 (2.98-5.96)	4.13 (2.70- 5.55)
Full-time	63.04 (61.27-64.81)	44.08 (40.49-47.68)	58.83 (55.78-61.87)	74.93 (71.70-78.16)	77.76 (74.63- 80.90)
Pension	0.65 (0.37-0.93)	1.00 (0.23-1.76)	0.24 (0.17-1.10)	0.41 (0.00-0.86)	0.53 (0.01-1.05)
	<u>M (95% CL)</u>	<u>M (95% CL)</u>	<u>M (95% CL)</u>	<u>M (95% CL)</u>	<u>M (95% CL)</u>
Age	32.12 (32.00-32.26)	32.70 (32.48-32.93)	32.19 (31.98-32.39)	31.92 (31.69-32.15)	31.64 (31.42-31.88)

Note. Percent refers to proportion of demographic characteristic within drinking category (e.g., 82.81 % of non-binge drinkers were women).

Table 2
Past Year Drinking Behavior by Drinking Category

	Non-Binge M (95% CL)	Binge M (95% CL)	HIL M (95% CL)	HIH M (95% CL)	Wald F (3, 827-2262)
Drinking Frequency					
Total	31.99 (27.90-36.08)	75.72 (70.91-80.54)	110.76 (104.07-117.42)	143.91 (135.02-151.81)	96.48, <i>p</i><.0001
Men	48.84 (34.83-62.84)	88.60 (79.42-97.77)	123.20 (112.95-133.46)	160.48 (150.76-170.20)	32.18, <i>p</i><.0001
Women	28.49 (24.55-32.43)	70.37 (64.76-75.97)	98.97 (90.45-107.49)	116.67 (104.07-129.28)	49.53, <i>p</i><.0001
Drunk Frequency					
Total	0.30 (0.22-0.38)	5.40 (4.60-6.19)	17.68 (15.65-19.71)	42.37 (37.89-46.85)	42.26, <i>p</i><.0001
Men	0.31 (0.08-0.53)	6.52 (5.04-8.00)	20.50 (17.13-23.87)	47.26 (41.54-57.98)	18.51, <i>p</i><.0001
Women	0.30 (0.21-0.38)	4.93 (4.00-5.86)	15.01 (12.75-17.28)	34.33 (27.23-41.43)	20.82, <i>p</i><.0001
Binge Frequency					
Total	0.80 (.29-1.30)	11.45 (10.11-12.79)	38.92 (35.19-42.66)	78.18 (72.21-84.16)	50.93, <i>p</i><.0001
Men	0.68 (0.18-1.18)	17.85 (15.01-20.69)	46.94 (41.00-52.88)	90.14 (82.49-97.79)	32.36, <i>p</i><.0001
Women	0.82 (0.22-1.42)	8.79 (7.35-10.23)	31.33 (26.96-35.71)	58.52 (49.54-67.50)	17.40, <i>p</i><.0001
Typical Quantity					
Total	1.63 (1.59-1.66)	2.47 (2.37-2.57)	3.40 (3.24-3.56)	4.74 (4.47-5.02)	139.08, <i>p</i><.0001
Men	1.80 (1.69-1.92)	2.72 (2.53-2.90)	3.58 (3.35-3.82)	5.22 (4.84-5.61)	57.41, <i>p</i><.0001
Women	1.59 (1.56-1.62)	2.37 (2.26-2.48)	3.23 (3.03-3.43)	3.96 (3.61-4.32)	66.36, <i>p</i><.0001

Note. Frequency measured in one day units, quantity measured in standard drinks; all drinking groups differ from all others on every measure, *p*<.0001.

Table 3
Endorsement of Big Five Personality Traits by Sex and Drinking Category

	Non-Binge M (95% CL)	Binge M (95% CL)	HIL M (95% CL)	HIH M (95% CL)	Wald F (3, 894-2145)
Neur.					
Total	49.50 (48.78-50.21)	49.91 (49.29-50.54)	49.91 (49.14-50.69)	50.16 (49.37-50.95)	0.54, $p=.66$
Men	50.38 (48.61-52.15)	49.43 (48.32-50.53)	49.96 (48.89- 51.05)	50.34 (49.33-51.34)	0.51, $p=.68$
Women	48.89 (48.15-49.64) ^{a‡b*c}	50.01 (49.30-50.72) ^{d‡}	50.65 (49.59-51.72) ^{d*}	51.78 (50.55-53.01) ^{a*d}	5.58, $p=.001$
Extrav.					
Total	49.22 (48.50-49.94) ^{b*c}	50.12 (49.50-50.74) ^{c‡}	50.57 (49.80-51.33) ^{d*}	51.31 (50.52-52.10) ^{a‡d}	5.19, $p=.001$
Men	47.87 (46.02- 49.72) ^{c*}	49.51 (48.41- 50.62) ^{c‡}	49.84 (48.78- 50.92)	51.16 (50.17- 52.15) ^{a‡d*}	3.80, $p=.01$
Women	49.01 (48.24-49.79) ^{b*c*}	49.95 (49.24-50.66)	50.91 (49.88-51.94) ^{d*}	51.31 (50.07-52.54) ^{d*}	4.23, $p=.005$
Open.					
Total	49.98 (49.24-50.71)	50.86 (50.24-51.49)	50.13 (49.38-50.88)	49.67 (48.85-50.49)	6.64, $p=.08$
Men	50.54 (48.69- 52.38)	51.32 (50.20- 52.44) ^{b‡c*}	49.42 (48.36- 50.48) ^{a‡}	49.30 (48.30- 50.29) ^{a*}	2.81, $p=.04$
Women	49.30 (48.52-50.07)	50.23 (49.54-50.92)	50.55 (49.52-51.58)	50.32 (48.99-51.64)	1.54, $p=.20$
Agree.					
Total	53.02 (52.33-53.70) ^{abc}	50.13 (49.52-50.74) ^{b*c‡d}	48.37 (47.60-49.13) ^{a*c‡d}	47.10 (46.31-47.89) ^{ab‡d}	41.07, $p<.0001$
Men	52.71 (50.88-54.55) ^{b*c*}	51.25 (50.19-52.30) ^{b*c*}	49.37 (48.29-50.45) ^{a*d*}	48.70 (47.70-49.70) ^{a*d*}	6.57, $p=.0002$
Women	52.24 (51.53-52.96) ^{abc}	49.37 (48.65-50.09) ^d	48.77 (47.69-49.84) ^d	47.99 (46.78-49.20) ^d	15.13, $p<.0001$
Consc.					
Total	52.33 (51.62-53.04) ^{abc}	50.39 (49.79-50.99) ^{b*c‡d}	48.65 (47.89-49.42) ^{a*d}	47.99 (47.18-48.80) ^{ad}	24.84, $p<.0001$
Men	50.70 (48.91-52.49)	50.69 (49.62-51.77)	50.08 (48.98-51.18)	49.19 (48.19-50.20)	1.55, $p=.20$
Women	52.04 (51.31-52.76) ^{a*bc}	49.99 (49.28-50.70) ^{d*}	47.95 (46.91-48.99) ^{a*d}	47.82 (46.54-49.10) ^{a*d}	16.81, $p<.0001$

Note. Scale standardized to t scores such that M=50, SD=10; scales standardized within total sample, men, and women separately such that mean and SD are relative to each group; a=differs from binge; b=differs from HIL; c=differs from HIH; d=differs from non-binge; test significant at $p<.0001$ unless noted; * $p<.01$; ‡ $p<.05$.

Table 4
Family History of Alcohol Problems by Drinking Category

	Non-Binge % (95% CL)	Binge % (95% CL)	HIL % (95% CL)	HIH % (95% CL)	Rao Scott ² df=3
Father					
Total	3.46 (2.84- 4.08)	4.33 (3.63-5.02)	3.19 (2.60-3.79)	3.52 (2.90-4.15)	2.44, <i>p</i> =.49
Men	1.10 (0.52-1.67)	1.96 (1.20-2.72)	2.98 (2.04-3.91)	4.78 (3.61-5.95)	5.44, <i>p</i> =.14
Women	4.92 (3.99-5.85)	5.79 (4.78-.679)	3.33 (2.55-4.10)	2.75 (2.04-3.45)	4.62, <i>p</i> =.20
Mother					
Total	0.50 (.26-.74)	1.30 (0.92-1.68)	0.68 (0.40-0.96)	0.74 (0.45-1.03)	4.30, <i>p</i> =.23
Men	0.08 (0.00-0.23)	0.78 (0.30-1.26)	0.39 (0.05-0.73)	0.86 (0.35-1.36)	3.55, <i>p</i> =.31
Women	0.76 (0.39-1.13)	1.62 (1.08-2.16)	0.86 (0.46-1.25)	0.67 (0.32-1.02)	5.14, <i>p</i> =.16
Twin					
Total	1.38 (0.96-1.80) ^{b*c}	2.62 (2.04-3.20) ^c	2.29 (1.75-2.82) ^{c†,d*}	3.29 (2.65-3.94) ^{ab†,d}	35.08, <i>p</i><.0001
Men	0.64 (0.17-1.11)	3.01 (2.00-4.02)	3.37 (2.30-4.44)	6.38 (4.93-7.83)	9.91, <i>p</i>=.02
Women	1.81 (1.21-2.41) ^{b†,c*}	2.40 (1.70-3.09) ^{c†}	1.65 (1.07-2.23) ^{d†}	1.49 (0.94-2.04) ^{a†,d*}	9.87, <i>p</i>=.02
Current Partner					
Total	1.59 (1.13-2.04) ^{c*}	2.59 (2.01-3.16) ^{c†}	1.66 (1.19-2.12) ^{c†}	2.38 (1.82-2.93) ^{a†,b†,d*}	10.04, <i>p</i>=.02
Men	0.28 (0.00-0.60)	0.66 (0.17-1.14)	0.84 (0.29-1.39)	2.06 (1.21-2.92)	5.76, <i>p</i> =.12
Women	2.35 (1.65-3.04) ^{c*}	3.71 (2.84-4.56) ^{c†}	2.13 (1.47-2.79) ^{c†}	2.56 (1.84-3.29) ^{a†,b†,d*}	29.71, <i>p</i><.0001

Note. a=differs from binge; b=differs from HIL; c=differs from HIH; d=differs from non-binge; test significant at *p*<.0001 unless noted; **p*<.01; †*p* ≤.02.

Table 5
 Childhood Behavioral Factors by Drinking Category

	Non-Binge M (95% CL)	Binge M (95% CL)	HIL M (95% CL)	HIH M (95% CL)	Wald F (3, 990-2262)
Age of First Drink					
Total	16.56 (16.38-16.73) ^{abc}	15.85 (15.72-15.98) ^{bcd}	15.29 (15.16-15.43) ^{ac,d}	15.03 (14.88-15.19) ^{ab,d}	45.57, p<.0001
Men	16.46 (15.98-16.94) ^{abc}	15.51 (15.25-15.76) ^{b,c*,d}	15.11 (14.93-15.30) ^{a,d}	14.93 (14.74-15.11) ^{a*,d}	10.82, p<.0001
Women	16.58 (16.39-16.76) ^{abc}	15.99 (15.84-16.14) ^{bcd}	15.46 (15.25-15.66) ^{ad}	15.21 (14.94-15.49) ^{ad}	24.55, p<.0001
	% (95% CL)	% (95% CL)	% (95% CL)	% (95% CL)	Rao Scott χ^2 df=3
ADHD Combined					
Total	2.87 (1.71-4.02) ^{b,d,c*}	2.97 (1.95-4.00) ^{b,c*}	5.02 (3.40-6.64) ^{a,d,d}	5.99 (4.29-7.69) ^{a*,d*}	15.69, p=.001
Men	5.07 (1.34-8.76)	3.99 (1.87-6.11)	5.01 (2.75-7.28)	6.21 (4.02-8.40)	2.01, p=.57
Women	2.41 (1.24-3.58) ^{b,d,c†}	2.55 (1.39-3.70) ^{b,c,d}	5.02 (2.71-7.34) ^{a,d,d}	5.63 (2.95-8.31) ^{a,d,d}	11.34, p=.01
ADHD Inattentive					
Total	2.00 (1.03-2.96)	1.98 (1.13-2.84)	3.12 (1.87-4.38)	3.33 (2.04-4.61)	5.64, p=.13
Men	4.35 (0.93-7.77)	2.45 (0.78-4.13)	3.06 (1.28-4.85)	3.64 (1.94-5.34)	1.44, p=.70
Women	1.51 (0.58-2.43)	1.79 (0.79-2.78)	3.17 (1.41-4.94)	2.82 (0.89-4.75)	4.63, p=.20
ADHD Hyperactive					
Total	1.50 (0.66-2.34) ^{c*}	1.53 (0.81-2.25) ^{c*}	2.31 (1.16-3.45)	3.72 (2.37-5.08) ^{b*,d*}	13.24, p=.004
Men	2.90 (0.09-5.71)	2.15 (0.58-3.71)	1.95 (0.52-3.83)	3.64 (1.94-5.34)	2.82, p=.42
Women	1.20 (0.38-2.03) ^{c†}	1.28 (0.49-2.06) ^{c*}	2.65 (0.87-4.42)	3.87 (1.63-6.12) ^{a*,d†}	11.27, p=.01
Conduct Disorder					
Total	4.74 (3.23-6.24) ^{b*,c*}	6.49 (5.00-7.97) ^{c*}	8.82 (6.75-10.89) ^{cd*}	19.44 (16.53-22.35) ^{a*,bd*}	119.90, p<.0001
Men	8.70 (3.95-13.45) ^c	10.12 (6.78-13.47) ^c	10.86 (7.58-14.15) ^c	24.36 (20.63-26.62) ^{abd}	47.53, p<.0001
Women	3.92 (2.39-5.44) ^{b,d,c}	4.97 (3.42-6.53) ^{c*}	6.88 (4.34-9.42) ^{d†}	10.92 (7.11-14.72) ^{a*,d}	19.52, p=.0002

Note. a=differs from binge; b=differs from HIL; c=differs from HIH; d=differs from non-binge; test significant at p<.0001 unless noted; *p≤.01; † p <.05.

Table 6
 Perception of Proportion of Peers Being Drunk at Least 1x/Month by Drinking Category

	Non-Binge M (95% CL)	Binge M (95% CL)	HIL M (95% CL)	HIH M (95% CL)	Wald F (3, 956-2254)
Male Friends					
Total	24.76 (22.45-27.07) ^{abc}	37.58 (35.47-39.69) ^{bcd}	54.24 (50.60-55.87) ^{acd}	67.36 (64.32-69.90) ^{abd}	146.73, p<.0001
Men	17.10 (13.16-21.04) ^{abc}	33.91 (30.40-37.42) ^{bcd}	51.60 (47.97-55.23) ^{acd}	69.81 (66.80-72.81) ^{abd}	75.10, p<.0001
Women	26.37 (23.73-29.00) ^{abc}	39.15 (36.56-41.74) ^{bcd}	54.80 (50.96-58.64) ^{ac*d}	63.29 (58.74-67.83) ^{ab*d}	65.29, p<.0001
Female Friends					
Total	12.32 (10.73-13.90) ^{abc}	21.41 (19.74-23.09) ^{bcd}	33.03 (30.61-35.46) ^{acd}	44.83 (42.15-47.52) ^{abd}	96.43, p<.0001
Men	12.37 (8.72-16.02) ^{a,‡bc}	18.34 (15.59-21.10) ^{bcd,‡}	29.79 (26.62-32.96) ^{acd}	43.36 (40.04-46.67) ^{abd}	35.57, p<.0001
Women	12.30 (10.54-14.06) ^{abc}	22.70 (20.64-24.77) ^{bcd}	36.08 (32.49-39.86) ^{acd}	47.26 (42.71-51.81) ^{abd}	62.33, p<.0001
Coworkers					
Total	23.38 (21.44-25.32) ^{abc}	28.80 (27.05-30.56) ^{bcd}	38.72 (36.34-41.09) ^{acd}	49.49 (46.86-52.13) ^{abd}	85.37, p<.0001
Men	22.61 (18.17-27.06) ^{a,‡bc}	31.72 (28.42-35.03) ^{bcd,‡}	42.20 (38.83-45.57) ^{acd}	53.04 (49.80-56.29) ^{abd}	34.55, p<.0001
Women	23.54 (21.43-25.65) ^{a*bc}	27.62 (25.59-29.65) ^{bcd*}	35.41 (32.09-38.73) ^{ac*d}	43.56 (39.44-47.67) ^{ab*d}	29.70, p<.0001

Note. a=differs from binge; b=differs from HIL; c=differs from HIH; d=differs from non-binge; test significant at $p < .0001$ unless otherwise noted; * $p < .01$; † $p < .05$.

Table 7

Prevalence of Past Year Drinking Related Consequences in Heavy Drinkers

	Binge % (95% CL)	HIL % (95% CL)	HIH % (95% CL)	Rao Scott χ^2 df=3
Blackout				
Total	2.43 (1.52-3.34) ^{b‡c}	12.20 (9.78-14.61) ^{a‡c}	28.10 (24.79-31.41) ^{ab}	274.08, p<.0001
Men	0.92 (0.00-1.96) ^{b‡c}	10.59 (7.41-13.76) ^{a‡c}	27.41 (23.31-31.51) ^{ab}	122.90, p<.0001
Women	3.07 (1.86-4.27) ^{bc}	13.72 (10.14-17.30) ^{ac}	29.23 (23.74-34.71) ^{ab}	146.38, p<.0001
Pass Out				
Total	3.25 (2.15-4.34) ^{b*c}	13.01 (10.53-15.49) ^{a*c}	21.57 (18.58-24.56) ^{ab}	142.63, p<.0001
Men	2.14 (0.57-3.73) ^{b‡c}	11.42 (7.99-14.86) ^{a‡c}	20.77 (17.12-24.42) ^{ab}	59.87, p<.0001
Women	3.70 (2.30-5.11) ^{b‡c}	14.51 (10.92-18.11) ^{a‡c}	22.89 (17.91-27.87) ^{ab}	86.76, p<.0001
AUD				
Total	2.16 (1.31-3.02) ^{bc}	12.60 (10.21-15.00) ^{ac}	28.76 (25.52-32.00) ^{ab}	286.70, p<.0001
Men	2.45 (0.77-1.14) ^{bc}	10.86 (7.64-14.09) ^{ac}	33.40 (29.12-37.69) ^{ab}	147.99, p<.0001
Women	2.04 (1.05-3.04) ^{bc}	14.25 (10.72-17.77) ^{ac‡}	21.13 (16.37-25.88) ^{ab‡}	110.11, p<.0001

Note. Prevalence relative to column category (e.g., 3.25% of binge drinkers passed out); non-binge only drinkers excluded due to near-zero prevalence of consequences; a=differs from binge; b=differs from HIL; c=differs from HIH; test significant at p<.0001 unless noted; *p<.01; ‡ p <.05.

Figures

Figure 1
Typical Quantity per Drinking Occasion by Sex

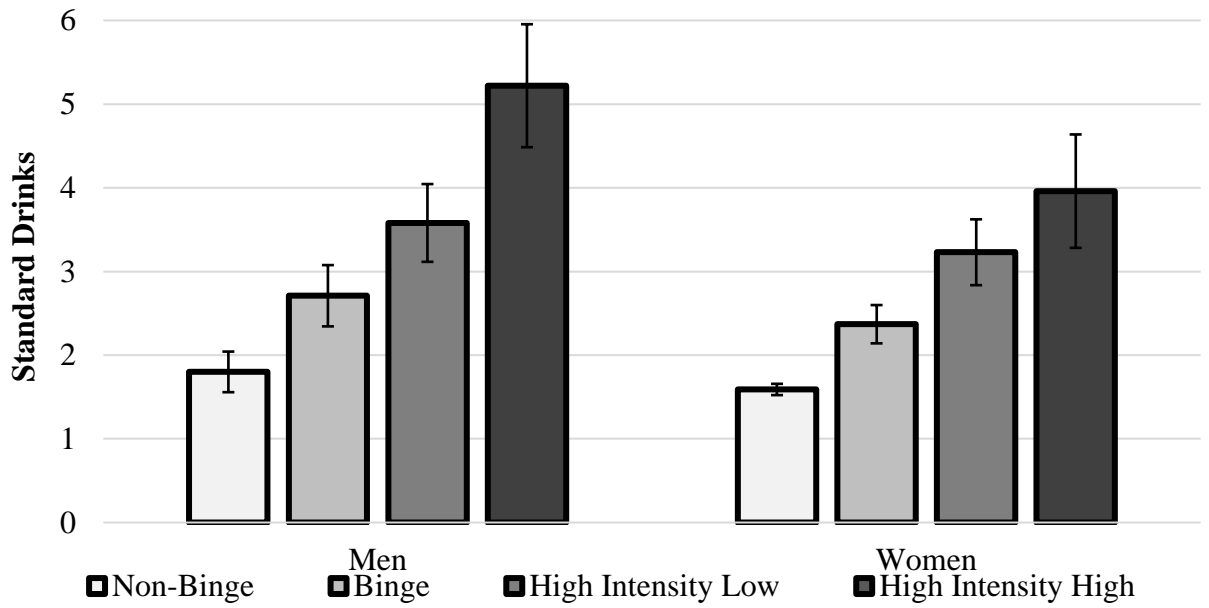
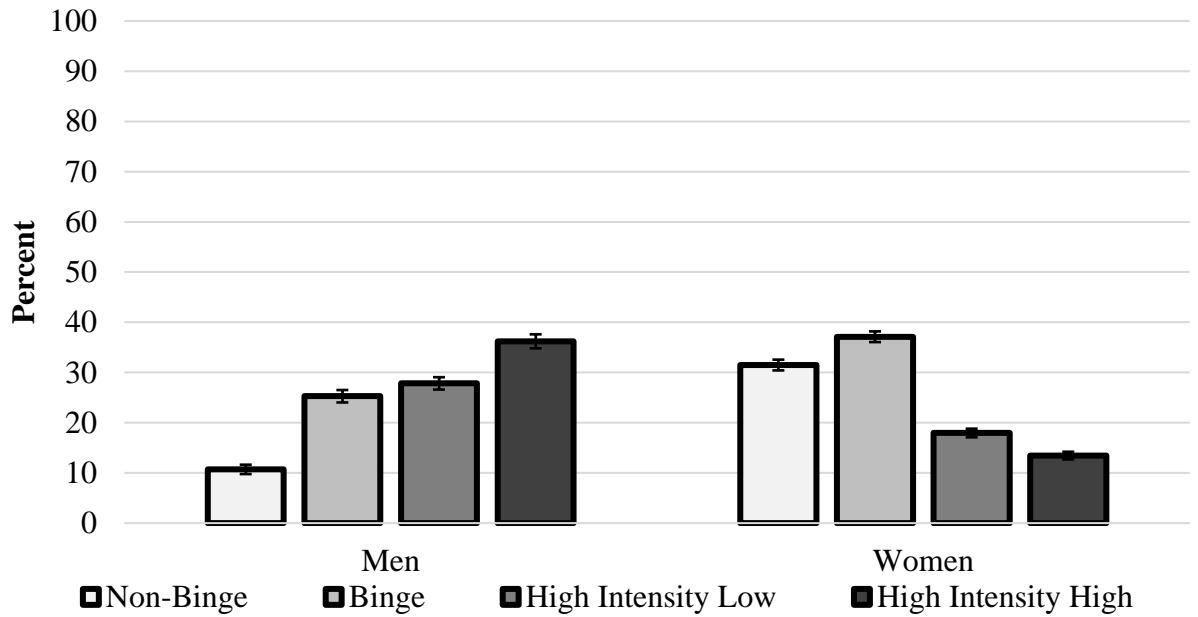


Figure 2
Prevalence of HID by Sex



Supplementary Tables

Table S1

Odds Ratios for Demographic Characteristic and Drinking Category Associations

	Non-Binge		Binge		High Intensity Low		High Intensity High	
	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference							
Sex			2.01 (1.58-2.54)		4.56 (3.56-5.86)		7.92 (6.16-10.20)	
Age			0.95 (0.92-0.98)	0.94 (0.91-0.97)	0.92 (0.89-0.95)	0.91 (0.87-0.94)	0.89 (0.86-0.92)	0.87 (0.84-0.91)
Income			1.02 (0.98-1.07)	1.02 (0.97-1.06)	1.07 (1.01-1.12)	1.05 (0.99-1.11)	1.06 (1.01-1.11)	1.03 (0.98-1.09)
Educ			0.98 (0.90-1.05)	0.99 (0.91-1.07)	0.91 (0.84-0.99)	0.94 (0.86-1.02)	0.76 (0.70-0.83)	0.80 (0.73-0.87)
Mar Stat			1.74 (1.42-2.14)	1.75 (1.43-2.16)	2.97 (2.39-3.70)	3.03 (2.42-3.79)	3.44 (2.74-4.31)	3.53 (2.78-4.48)
	Reference							
Sex	0.50 (0.39-0.63)				2.28 (1.87-2.76)		3.95 (3.23-4.84)	
Age	1.06 (1.03-1.09)	1.06 (1.03-1.10)			0.97 (0.94-1.00)	.096 (0.93-0.99)	0.94 (0.91-0.97)	0.93 (0.89-0.96)
Income	0.98 (0.94-1.02)	0.98 (0.94-1.03)			1.04 (0.99-1.10)	1.03 (0.98-1.09)	1.03 (0.98-1.09)	1.02 (0.97-1.07)
Educ	1.03 (0.95-1.11)	1.01 (0.94-1.09)			0.94 (0.87-1.01)	0.95 (0.88-1.03)	0.78 (0.73-0.85)	0.81 (0.75-0.87)
Mar Stat	0.57 (0.47-0.70)	0.57 (0.46-0.70)			1.71 (1.41-2.07)	1.73 (1.42-2.10)	1.97 (1.61-2.42)	2.01 (1.63-2.48)
	Reference							
Sex	0.22 (0.18-0.28)		0.44 (0.36-0.53)				1.74 (1.41-2.14)	
Age	1.09 (1.05-1.13)	1.10 (1.07-1.14)	1.03 (0.99-1.07)	1.04 (1.01-1.08)			0.97 (0.94-1.01)	0.96 (0.93-0.99)
Income	0.94 (0.89-0.99)	0.95 (0.90-1.00)	0.96 (0.91-1.01)	0.97 (0.92-1.02)			0.99 (0.94-1.05)	0.98 (0.93-1.04)
Educ	1.10 (1.01-1.19)	1.07 (0.98-1.16)	1.07 (0.99-1.15)	1.05 (0.97-1.14)			0.84 (0.77-0.91)	0.85 (0.78-0.92)
Mar Stat	0.34 (0.27-0.42)	0.33 (0.26-0.41)	0.59 (0.48-0.71)	0.58 (0.48-0.70)			1.16 (0.93-1.44)	1.17 (0.94-1.45)

Note. Unadjusted/Adjusted=before/after controlling for sex; Educ=educational attainment; Mar Stat=marital status (single vs. married/defaulto); bold indicates significance ($p < .0001-.04$).

Table S2.

Odds Ratios for Past Year Drinking Behavior and Drinking Category Associations

	Non-Binge		Binge		High Intensity Low		High Intensity High	
	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference							
Drink			1.17 (1.13-1.21)	1.16 (1.12-1.19)	1.23 (1.19-1.28)	1.21 (1.17-1.25)	1.28 (1.23-1.33)	1.25 (1.21-1.29)
Drunk			22.17 (7.40-66.44)	19.19 (6.39-57.67)	37.99 (12.66-114)	31.37 (10.42-94.43)	45.00 (14.99-135.16)	36.84 (12.23-110.98)
Binge			2.00 (0.82-4.86)	1.90 (0.80-4.52)	2.88 (1.18-7.07)	2.69 (1.13-6.43)	3.22 (1.31-7.89)	2.98 (1.25-7.14)
Quantity			2.76 (2.38-3.21)	2.67 (2.30-3.10)	3.72 (3.20-4.33)	3.50 (3.00-4.07)	4.39 (3.77-5.12)	4.08 (3.50-4.77)
	Reference							
Drink	0.86 (0.83-0.89)	0.87 (0.84-0.89)			1.06 (1.04-1.07)	1.05 (1.03-1.06)	1.09 (1.08-1.11)	1.08 (1.07-1.10)
Drunk	0.05 (0.02-0.14)	0.05 (0.02-0.16)			1.71 (1.44-2.04)	1.63 (1.38-1.94)	2.03 (1.69-2.44)	1.92 (1.61-2.29)
Binge	0.50 (0.21-1.22)	0.53 (0.22-1.25)			1.44 (1.33-1.57)	1.41 (1.30-1.53)	1.61 (1.48-1.75)	1.57 (1.44-1.71)
Quantity	0.36 (0.31-0.42)	0.38 (0.32-0.44)			1.35 (1.26-1.44)	1.31 (1.23-1.40)	1.59 (1.48-1.71)	1.53 (1.42-1.64)
	Reference							
Drink	0.81 (0.78-0.84)	0.83 (0.80-0.86)	0.95 (0.94-0.96)	0.96 (0.94-0.97)			1.04 (1.03-1.05)	1.03 (1.02-1.05)
Drunk	0.03 (0.01-0.08)	0.03 (0.01-0.10)	0.58 (0.49-0.70)	0.61 (0.52-0.73)			1.19 (1.13-1.24)	1.17 (1.13-1.23)
Binge	0.35 (0.14-0.85)	0.37 (0.16-0.89)	0.69 (0.64-0.75)	0.71 (0.65-0.77)			1.12 (1.08-1.14)	1.11 (1.08-1.14)
Quantity	0.27 (0.23-0.31)	0.29 (0.25-0.33)	0.74 (0.70-0.79)	0.76 (0.72-0.82)			1.18 (1.13-1.23)	1.17 (1.12-1.22)

Note. Unadjusted/Adjusted=before/after controlling for sex; bold indicates significance ($p < .0001-.03$).

Table S3.
Odds Ratios for Personality Trait and Drinking Category Associations

	Non-Binge		Binge		High Intensity Low		High Intensity High	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference							
Neur.			1.04 (0.95-1.15)	1.08 (0.98-1.20)	1.04 (0.94-1.16)	1.15 (1.03-1.29)	1.07 (0.96-1.16)	1.23 (1.09-1.38)
Extra.			1.10 (1.00-1.20)	1.12 (1.01-1.23)	1.15 (1.03-1.27)	1.20 (1.07-1.33)	1.24 (1.11-1.38)	1.31 (1.17-1.47)
Open.			1.10 (1.00-1.20)	1.11 (1.01-1.22)	1.02 (0.92-1.130)	1.05 (0.95-1.17)	0.97 (0.87-1.08)	1.02 (0.91-1.15)
Agree.			0.71 (0.64-0.80)	0.75 (0.67-0.84)	0.59 (0.53-0.67)	0.67 (0.60-0.76)	0.52 (0.47-0.59)	0.62 (0.55-0.71)
Consc.			0.81 (0.73-0.89)	0.83 (0.75-0.92)	0.68 (0.61-0.76)	0.72 (0.64-0.81)	0.63 (0.57-0.71)	0.69 (0.61-0.78)
	Reference							
Neur.	0.96 (0.87-1.06)	0.49 (0.84-1.02)			1.00 (0.87-1.06)	1.06 (0.96-1.17)	1.03 (0.93-1.14)	1.13 (1.02-1.26)
Extra.	0.91 (0.83-1.00)	0.90 (0.82-0.99)			1.05 (0.95-1.16)	1.07 (0.97-1.19)	1.13 (1.02-1.26)	1.18 (1.06-1.31)
Open.	0.91 (0.83-1.00)	0.90 (0.82-0.99)			0.93 (0.84-1.02)	0.95 (0.86-1.15)	0.89 (0.80-0.98)	0.92 (0.83-1.02)
Agree.	1.40 (1.26-1.56)	1.33 (1.20-1.49)			0.83 (0.75-0.92)	0.90 (0.81-0.99)	0.74 (0.67-0.81)	0.83 (0.75-0.92)
Consc.	1.24 (1.12-1.34)	1.21 (1.09-1.34)			0.84 (0.76-0.92)	0.87 (0.79-0.96)	0.79 (0.71-0.87)	0.83 (0.75-0.92)
	Reference							
Neur.	0.96 (0.86-1.07)	0.87 (0.78-0.97)	1.00 (0.90-1.10)	0.94 (0.85-1.04)			1.03 (0.92-1.15)	1.07 (0.96-1.20)
Extra.	0.87 (0.79-0.97)	0.84 (0.75-0.93)	0.96 (0.87-1.05)	0.93 (0.84-1.03)			1.08 (0.97-1.21)	1.10 (0.98-1.23)
Open.	0.98 (0.89-1.09)	0.95 (0.85-1.06)	1.08 (0.98-1.18)	1.05 (0.96-1.16)			0.95 (0.86-1.06)	0.97 (0.87-1.08)
Agree.	1.67 (1.50-1.90)	1.49 (1.32-1.68)	1.20 (1.09-1.33)	1.12 (1.01-1.24)			0.88 (0.80-0.98)	0.93 (0.83-1.03)
Consc.	1.48 (1.32-1.65)	1.39 (1.24-1.56)	1.19 (1.08-1.31)	1.15 (1.05-1.27)			0.94 (0.85-1.04)	0.96 (0.86-1.07)

Note. Unadjusted/Adjusted=before/after controlling for sex; bold indicates significance ($p < .0001-.03$).

Table S4.
Odds Ratios for Family History and Drinking Category Associations

	Non-Binge OR (95% CI)		Binge OR (95% CI)		High Intensity Low OR (95% CI)		High Intensity High OR (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference							
FH Mother			1.17 (1.00-1.38)	1.20 (1.02-1.41)	1.10 (0.92-1.33)	1.16 (0.96-1.40)	1.12 (0.94-1.33)	1.21 (1.02-1.45)
FH Father			0.97 (0.91-1.04)	0.99 (0.92-1.06)	1.00 (0.93-1.08)	1.05 (0.97-1.13)	1.02 (0.95-1.10)	1.09 (1.01-1.18)
FH Twin			1.10 (1.00-1.22)	1.08 (0.98-1.20)	1.18 (1.07-1.31)	1.14 (1.03-1.26)	1.30 (1.18-1.43)	1.23 (1.11-1.36)
FH Partner			1.06 (0.96-1.16)	1.09 (0.99-1.20)	1.05 (0.94-1.16)	1.14 (1.03-1.27)	1.16 (1.05-1.28)	1.33 (1.20-1.48)
	Reference							
FH Mother	0.85 (.073-1.00)	0.84 (0.71-0.98)			0.94 (0.82-1.08)	0.97 (0.84-1.12)	0.96 (0.85-1.08)	1.01 (0.89-1.15)
FH Father	1.03 (0.96-1.10)	1.01 (0.95-1.09)			1.03 (0.96-1.10)	1.06 (0.99-1.34)	1.06 (0.99-1.13)	1.11 (1.03-1.19)
FH Twin	0.91 (0.82-1.00)	0.92 (0.84-1.02)			1.07 (0.99-1.17)	1.05 (0.96-1.15)	1.18 (1.09-1.28)	1.14 (1.04-1.24)
FH Partner	0.95 (0.86-1.04)	0.92 (0.84-1.01)			0.99 (0.90-1.09)	1.05 (0.96-1.16)	1.10 (1.01-1.20)	1.22 (1.12-1.34)
	Reference							
FH Mother	0.91 (0.76-1.09)	0.86 (0.71-1.04)	1.06 (0.93-1.23)	1.03 (0.89-1.19)			1.02 (0.87-1.19)	1.04 (0.89-1.22)
FH Father	1.00 (0.93-1.08)	0.96 (0.89-1.03)	0.97 (0.91-1.04)	0.94 (0.88-1.01)			1.02 (0.95-1.10)	1.05 (0.97-1.13)
FH Twin	0.85 (0.77-0.93)	0.88 (0.79-0.97)	0.93 (0.86-1.01)	0.95 (0.87-1.04)			1.10 (1.01-1.20)	1.08 (0.99-1.18)
FH Partner	0.95 (0.86-1.06)	0.87 (0.79-0.97)	1.01 (0.92-1.11)	0.95 (0.86-1.05)			1.11 (1.00-1.22)	1.16 (1.05-1.28)

Note. Unadjusted/Adjusted=before/after controlling for sex; FH=family history; bold indicates significance ($p < .0001-.05$).

Table S5.
Odds Ratios for Childhood Externalizing Disorders and Drinking Category Associations

	Non-Binge		Binge		High Intensity Low		High Intensity High	
	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference							
AFD			0.85 (0.81-0.89)	0.86 (0.81-0.90)	0.74 (0.70-0.78)	0.76 (0.72-0.81)	0.70 (0.65-0.74)	0.72 (0.68-0.77)
ADHD C			1.01 (0.59-1.73)	0.97 (0.56-1.68)	1.79 (1.06-3.04)	1.64 (0.94-2.87)	2.16 (1.29-3.62)	1.91 (1.09-3.35)
ADHD I			0.95 (0.48-1.86)	0.91 (0.46-1.79)	1.58 (0.83-3.03)	1.41 (0.70-2.83)	1.69 (0.89-3.20)	1.44 (0.71-2.90)
ADHD H			.096 (0.47-1.99)	0.94 (0.45-1.96)	1.55 (0.74-3.26)	1.47 (0.67-3.24)	2.55 (1.29-5.06)	2.37 (1.11-5.07)
CD			1.40 (0.93-2.11)	1.25 (0.82-1.89)	1.95 (1.28-2.96)	1.49 (0.97-2.30)	4.85 (3.31-7.10)	3.40 (2.28-5.07)
	Reference							
AFD	1.18 (1.12-1.24)	1.17 (1.11-1.23)			0.87 (0.83-0.91)	0.89 (0.84-0.93)	0.82 (0.78-0.87)	0.85 (0.80-0.89)
ADHD C	0.99 (0.58-1.71)	1.03 (0.60-1.78)			1.78 (1.09-2.91)	1.69 (1.02-2.79)	2.15 (1.34-3.44)	1.97 (1.20-3.23)
ADHD I	1.06 (0.54-2.06)	1.11 (0.56-2.19)			1.67 (0.90-3.09)	1.56 (0.83-2.92)	1.78 (0.98-3.27)	1.59 (0.85-2.97)
ADHD H	1.04 (0.50-2.15)	1.06 (0.51-2.20)			1.61 (0.81-3.21)	1.56 (0.77-3.18)	2.65 (1.42-4.92)	2.51 (1.28-4.89)
CD	0.72 (0.48-1.08)	0.80 (0.53-1.21)			1.39 (0.99-1.97)	1.19 (0.84-1.70)	3.48 (2.57-4.70)	2.72 (2.00-3.71)
	Reference							
AFD	1.36 (1.28-1.44)	1.32 (1.24-1.40)	1.15 (1.09-1.21)	1.13 (1.07-1.18)			0.95 (0.90-0.99)	0.95 (0.91-1.00)
ADHD C	0.56 (0.33-0.95)	0.61 (0.35-1.07)	0.56 (0.34-0.92)	0.59 (0.34-0.98)			1.21 (0.77-1.89)	1.16 (0.74-1.83)
ADHD I	0.63 (0.33- 1.21)	0.71 (0.35-1.42)	0.60 (0.32-1.11)	0.64 (0.34-1.20)			1.07 (0.60-1.91)	1.02 (0.57-1.82)
ADHD H	0.64 (0.31-1.35)	0.68 (0.31-1.49)	0.62 (0.31-1.23)	0.64 (0.31-1.31)			1.64 (0.87-3.09)	1.61 (0.85-3.03)
CD	0.51 (0.34-0.78)	0.67 (0.44-1.04)	0.72 (0.51-1.02)	0.84 (0.59-1.20)			2.50 (1.83-3.40)	2.29 (1.68-3.12)

Note. Unadjusted/Adjusted=before/after controlling for sex; AFD=age of first drink; ADHD C=combined type; ADHD I=inattentive type; H=hyperactive type; CD=conduct disorder; bold indicates significance ($p<.0001-.04$).

Table S6.
Odds Ratios for Perceived Peer Use and Drinking Category Associations

	Non-Binge OR (95% CI)		Binge OR (95% CI)		High Intensity Low OR (95% CI)		High Intensity High OR (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference							
Coworkers			2.08 (1.45-2.98)	1.92 (1.34-2.75)	5.75 (3.97-8.34)	4.81 (3.30-7.02)	14.52 (9.99-21.10)	11.44 (7.80-16.78)
M Friends			3.49 (2.52-4.84)	3.40 (2.48-4.68)	11.34 (8.05-15.98)	11.47 (8.14-16.16)	33.29 (23.11-47.96)	36.23 (24.79-52.97)
F Friends			6.25 (3.58-10.93)	5.90 (3.46-10.08)	24.94 (12.23-37.78)	21.70 (12.54-37.56)	54.17 (30.55-96.05)	60.47 (34.34-106.47)
	Reference							
Coworkers	0.48 (0.34-0.69)	0.52 (0.36-0.75)			2.77 (2.06-3.74)	2.51 (1.85-3.40)	6.99 (5.17-9.45)	5.96 (4.38-8.12)
M Friends	0.29 (0.21-0.40)	0.29 (0.21-0.40)			3.25 (2.52-4.19)	3.37 (2.60-4.37)	9.53 (7.24-12.55)	10.65 (7.93-14.29)
F Friends	0.16 (.09-0.28)	0.17 (0.10-0.29)			3.44 (2.53-4.68)	3.68 (2.70-5.01)	8.66 (6.38-11.77)	10.24 (7.44-14.10)
	Reference							
Coworkers	0.17 (0.12-0.25)	0.21 (0.14-0.30)	0.36 (0.27-0.49)	0.40 (0.29-0.54)			2.52 (1.86-3.43)	2.38 (1.75-3.23)
M Friends	0.09 (0.06-0.12)	0.09 (0.06-0.12)	0.31 (0.24-0.40)	0.30 (0.23-0.39)			2.94 (2.21-3.90)	3.16 (2.35-4.24)
F Friends	0.05 (0.03-0.08)	0.05 (0.03-0.08)	0.29 (0.21-0.40)	0.27 (0.20-0.37)			2.52 (1.89-3.35)	2.79-2.08-3.74)

Note. Unadjusted/Adjusted=before/after controlling for sex; AFD=age of first drink; FH=family history; bold indicates significance ($p < .0001-.04$).

Table S7.
Odds Ratios for Alcohol Related Consequences and Drinking Category Associations

	Binge OR (95% CI)		High Intensity Low OR (95% CI)		High Intensity High OR (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Reference					
Blackout			3.65 (1.82-7.31)	3.73 (1.85-7.51)	11.74 (6.18-22.28)	12.20 (6.32-23.55)
Pass Out			5.24 (2.62-10.47)	5.33 (2.69-10.59)	8.66 (4.46-16.84)	8.93 (4.63-17.24)
AUD			6.52 (4.14-10.25)	6.19 (3.92-9.80)	18.25 (11.81-28.21)	16.78 (10.82-26.01)
	Reference					
Blackout	0.27 (0.14-0.55)	0.27 (0.13-0.54)			3.22 (5.08)	3.27 (2.06-5.19)
Pass Out	0.19 (0.10-0.38)	0.19 (0.09-0.37)			1.65 (1.10-2.48)	1.68 (1.112.52)
AUD	0.15 (0.10-0.24)	0.16 (0.10-0.26)			2.80 (2.14-3.67)	2.71 (2.07-3.54)

Note. Unadjusted/Adjusted=before/after controlling for sex; bold indicates significance ($p < .0001-.02$).