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## Alcohol dependence symptoms among recent onset adolescent drinkers

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### Abstract

This study examined prevalence of alcohol dependence symptoms and diagnosis among a nationally representative sample of recent onset adolescent drinkers aged 12–21 years (mean 17 years) across different levels of drinking drawn from National Survey of Drug Use and Health (N = 9,490). We assessed whether the relationship between level of alcohol use and alcohol dependence was similar for individuals from different socio-demographic groups (i.e., gender, age group, ethnic group, family income, and substance use in the past year). The most prevalent DSM-IV alcohol dependence criteria at low levels of alcohol use were “unsuccessful efforts to cut down”, “tolerance”, and “time spent” in activities necessary to obtain alcohol or recover from its effect. Logistic regression with polynomial contrasts indicated increasing rates of each criterion and an overall dependence diagnosis with increasing alcohol exposure that differed most between the lowest levels of recent drinking frequency. After controlling for drinking quantity, younger adolescents, females, Native American/Alaskans and Asian/Pacific Islanders were most likely to experience alcohol dependence symptoms and a diagnosis of dependence, suggesting that these demographic subgroups may experience dependence symptoms or develop dependence more quickly after beginning to drink. Recognizing early symptoms of alcohol dependence may assist in early identification and intervention of those at risk for heavier drinker in the future.

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## Keywords

Alcohol dependence; Alcohol exposure; Adolescents

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## 1. Introduction

Alcohol dependence has been estimated at 4% to 5% among American adults based on recent data from the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC) (Grant et al., 2004) and the National Comorbidity Survey Replication (NCS-R) (Kessler et al., 2005). Alcohol dependence is one of the most prevalent disorders worldwide and in the United States (Grant et al., 2004), is associated with a series of undesirable consequences such as illness, alcohol-related aggression and crime, lost productivity and conflicts with family members and/or friends (Hasin, Stinson, Ogburn, & Grant, 2007; Windle & Windle, 2005). The total expense of alcohol related consequences in the United States has been estimated at 4.21 billion U.S. dollars per month (Foster, Vaughan, Foster, & Califano, 2003).

Drinking most often begins in adolescence. Recent national surveillance data indicates that by 12th grade, 86% of adolescents have consumed alcohol and 55% are current drinkers, having consumed at least one drink in the past 30 days (Eaton et al., 2008). Previous research has also demonstrated that many teenage drinkers experience some alcohol dependence symptoms (e.g., tolerance, drinking larger amounts for a longer period of time than intended, spending a great deal of time on alcohol related activities) without an alcohol abuse or dependence diagnosis (Chung, Martin, Armstrong, & Labouvie, 2002; Hartford, Grant, Yi, & Chen, 2005; Nelson & Wittchen, 1998; Pollock & Martin, 1999), and that alcohol dependence symptoms tend to emerge sooner and progress faster for adolescents than adults (Deas, Riggs, Langenbucher, Goldman, & Brown, 2000; Chung, Martin, & Winter, 2005). Studies of adults further indicate that an early age of drinking onset (prior to age 14) considerably increases the likelihood of experiencing alcohol dependence symptoms and alcohol dependence in adulthood (Dawson et al., 2008; Hingson et al., 2006). Taken together, this research suggests that adolescent drinkers, particularly those with a very early onset, may be at risk for experiencing alcohol dependence symptoms soon after onset and for developing alcohol dependence and alcohol-related problems in adulthood.

While initiating drinking in very early adolescence is a risk factor for developing alcohol dependence, another well-established risk factor is higher levels of alcohol use, in terms of quantity and frequency (Caetano, Tam, Greenfield, Cherpitel, & Midanik, 1997; Dawson, Goldstein, Chou, Ruan, & Grant, 2008; Grant & Harford, 1990; Pollock & Martin, 1999). However, existing research on the development of alcohol dependence as a function of alcohol consumption has typically involved samples of adolescents with considerable variability in length of use, as measured by age of drinking onset. Although these studies often control for length of use, few have specifically examined the relation between prevalence of alcohol dependence symptoms across varying levels of alcohol use in adolescents who are newly exposed to alcohol.

Furthermore, there has been relatively little research examining the moderating role of individual socio-demographic characteristics in the association between alcohol dependence symptoms and alcohol exposure. Available research exploring socio-demographic characteristics (e.g. age, gender, ethnic groups) and alcohol dependence symptoms or diagnosis among youth with varying alcohol use histories have revealed that susceptibility to alcohol dependence appears to differ across individual socio-demographic profiles. For example, the risk of experiencing alcohol dependence was higher among older than younger

adolescents and for male late adolescents (i.e., 18-23 years old) compared to females (Hartford, Grant, Yi, & Chen, 2005). Non-Hispanic Whites tend to have higher rates of past year alcohol dependence compared to Hispanic, Black, and Asians (Chung, Martin, & Winter, 2005). Given these observed differences in rates of dependence, it is possible that socio-demographic subgroups may differ in their susceptibility to alcohol dependence symptoms across levels of alcohol exposure. In other words, individuals in some socio-demographic subgroups may be more likely to experience symptoms (or diagnosis) of alcohol dependence than individuals in other socio-demographic subgroups at similar levels of alcohol use.

The present study aims to 1) determine the prevalence of alcohol dependence symptoms and diagnosis among a nationally representative sample of recent onset drinkers across different levels of drinking; 2) and assess whether the relationship between level of alcohol use and alcohol dependence is similar for individuals from different socio-demographic groups (i.e., gender, age group, ethnic group, family income, and substance use in the past year). Data were combined from seven annual National Surveys on Drug Use and Health (NSDUH), one of the largest, nationally representative, epidemiologic studies to date that includes substantial heterogeneity in adolescent alcohol exposure, alcohol dependence symptoms as well as socio-demographic characteristics.

## 2. Method

### 2.1. Participants

Drawn from data combining seven annual NSDUH surveys (2002-2008), the sample consisted of  $N = 9,490$  individuals age 12-21 ( $M = 17.04$ ,  $SD = 0.03$ ) who reported (1) drinking in the past month, and (2) having had their first exposure to alcohol within the past 1 year. Given our focus on novice drinkers, we excluded 44,284 more experienced current adolescent drinkers (i.e. drank in the past month but had their first exposure to alcohol more than 1 year earlier). The NSDUH utilized multistage area probability methods to select a representative sample of the noninstitutionalized U.S. civilian population aged 12 or older. Persons living in households, military personnel living off bases, and residents of noninstitutional group quarters including college dormitories, group homes, civilians dwellings on military installations, as well as persons with no permanent residence are included. The NSDUH oversamples adolescent 12-17 to improve precision of substance use estimates.

Sample characteristics, adjusted for the complex survey design, as well as characteristics of the excluded sample of experienced current drinkers, are presented in Table 1. The study sample was 52.7 % female and mostly Caucasian (66.1%). Fifty-two percent ( $n = 5,151$ ) of adolescents were from either low-middle or high-middle class families and more than half of the participants (56.0%) had used other substances in addition to alcohol in past year. Most (69.3%) reported drinking 1-3 days in the past month, and on average, drank 3 to 4 drinks per day ( $SE = 0.05$ , range 1-30).

### 2.2. Measures

**2.2.1. Recent drinking frequency**—Recent drinking frequency was assessed by frequency of alcohol use in the past 30 days. Alcohol frequency was measured by asking participants how many days they drank in the past 30 days. Five alcohol frequency categories were created to represent drinking 1 day, 1.5-3 days, 4-5 days, 6-10 days, and more than 10 days in the past month.

**2.2.2. Alcohol dependence**—The NSDUH includes 13 items used to assess the seven alcohol dependence criteria (also referred to as symptoms in this study) listed in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (APA, 1994). Positive responses to 3 or more of 7 criteria (i.e., tolerance, withdrawal, using a larger amount over a longer period than intended, unsuccessful efforts to quit or cut down, great deal of time spent to obtain, use or recover from drinking, activities given up or reduced, and drinking despite physical or psychological problems caused by drinking), was defined as alcohol dependence. Table 2 presents the DSM-IV criteria and the corresponding items. The criteria were coded such that a positive response of any items under a given criterion was coded positively as having met the criterion.

**2.2.3. Socio-demographic characteristics**—Socio-demographic correlates include age (defined by age at interview in 2 categories, 12-17 years old and 18-21 years old), gender, race/ethnicity (Hispanic, non-Hispanic Black, Native American, Non-Hispanic Asian/Pacific Islanders, and non-Hispanic Interracial, and non-Hispanic White), family income (less than \$20,000, \$20,000-\$49,999, \$50,000-\$74,999, \$75,000 and more), and past year use of other substances (illicit drugs or cigarettes).

**2.2.4. Control variables**—Because recent-onset adolescent drinkers may vary in their alcohol exposure within the past year, having a well-established regular pattern of drinking or having consumed a great quantity of alcohol prior to the past 30 days could confound reports of current drinking frequency and endorsement of particular symptoms. In order to better reveal the relationships between recent drinking frequency and endorsements of alcohol dependence symptoms/diagnosis, past year alcohol use (consisting of the number of days in the past year that participants drank alcohol) and drinking quantity (average number of drinks per day in past month) was controlled for in the analyses. Because a very small number of participants had reported an excessive number of drinks per day (0.2%), reported numbers of drinks per day in excess of 30 drinks per day were recoded to 30 drinks.

### 2.3. Analysis

Logistic regression analyses with polynomial contrasts were used to evaluate the association between alcohol dependence and recent drinking frequency, controlling for alcohol use in the past year and drinking quantity in the last month. We tested linear, quadratic, and cubic trends in the probability of alcohol dependence symptom endorsement and alcohol dependence diagnosis as a function of increasing levels of recent drinking frequency in order to determine whether the slope of the relation between recent alcohol exposure and likelihood of alcohol dependence symptoms and diagnosis changed across levels of drinking. The Benjamini-Hochberg procedure (Benjamini & Hochberg, 1995) was used to adjust for increased Type I error rate related to multiple significance tests. Additionally, the area under the curve estimate (AUC) was used to evaluate the concordance between alcohol dependence and the levels of recent drinking frequency. Next, the association between individual socio-demographic characteristics and endorsement of alcohol dependence criteria as well as diagnosis were evaluated by logistic regression, controlling for past year alcohol use and the drinking quantity. Finally, we examined two-way interactions between socio-demographic characteristics and recent alcohol exposure to evaluate whether the relationship between recent alcohol exposure and alcohol dependence criteria and diagnosis differed as a function of socio-demographic characteristics. For the interaction analyses only, we combined the two heaviest drinking categories (drinking 6-10 days per month and >10 days per month) into a single category to ensure large enough samples to achieve adequate precision in the parameter estimates for the interactions. All analyses used appropriate sample weights to correct for the differences in the probability of selection, and

adjusted for survey design effects to obtain accurate standard errors via SAS (Version 9.1) survey procedures.

### 3. Results

#### 3.1. Prevalence of Alcohol Use and Alcohol Dependence

Figure 1 shows the proportion of recent onset drinkers endorsing each dependence criterion and an overall diagnosis by levels of recent alcohol exposure. The dependence criterion that was experienced most often at the lowest frequency of recent alcohol use (i.e., 1 day) was unsuccessful efforts to quit or cut down (22.7%). The least commonly endorsed dependence criteria at the highest frequency of recent alcohol use (i.e. 30 days) included using longer or larger amounts than intended (9.4%), reducing other activities to use alcohol (13.6%), withdrawal (15.6%), and drinking despite alcohol related emotional or health problems (15.7%). Results of the logistic regression models indicated that, overall, increasing levels of recent alcohol exposure were associated with greater likelihood of symptom endorsement. For most criteria, the likelihood of endorsement was significantly greater for all higher levels of recent alcohol exposure compared to the lowest level of exposure. Nearly 3% of the participants who drank 1 day in the past month met the criteria for a diagnosis of alcohol dependence, while 40% of participants who consumed drinks on more than 10 days in the past month met criteria for a diagnosis of alcohol dependence. Both past year alcohol use and drinking quantity were significantly related to all 7 criteria and alcohol dependence diagnosis, but their effects, independent of recent alcohol exposure, were extremely small.

An examination of the area under the ROC curve showed a moderate association between frequency of recent alcohol use and both alcohol dependence symptoms and diagnosis. The probability of a randomly selected individual endorsing alcohol dependence symptoms and/or diagnosis having a higher level of recent alcohol exposure than a randomly selected individual not endorsing alcohol dependence symptoms and/or diagnosis was .76 for tolerance, .70 for withdrawal, .74 for using a larger amount over a longer period than intended, .75 for unsuccessful efforts to quit or cut down, .81 for much time spent on alcohol use, .77 for reducing other activities, .76 for drinking despite emotional or health problems, and .78 for alcohol dependence diagnosis.

Table 4 presents the polynomial contrasts from logistic regression models. Overall, the significant positive linear trends for recent alcohol exposure and endorsement of the seven alcohol dependence criteria and diagnosis indicated that the likelihood of criteria endorsement and alcohol dependence diagnosis increased with increasing levels of recent alcohol exposure. Significant quadratic effects for all criteria and alcohol dependence diagnosis suggested a deceleration in the rate of increase in criteria endorsement between more moderate levels of exposure (e.g., 1.5-3 days; 4-5 days) (see Figure 1). A statistically significant positive cubic trend was found for some criteria and alcohol dependence diagnosis, which indicated a more rapid increase in endorsement between heavier levels of exposure. However, it is worthy to note that despite achieving statistical significance, the cubic trend coefficients were relatively small, indicating only slight increases in rate of endorsement and diagnosis between heavier levels of exposure.

#### 3.2. Socio-demographic Characteristics and Alcohol Dependence

Table 5 shows the associations between individual socio-demographic characteristics and alcohol dependence criteria and diagnosis from logistic regression models controlling for past year alcohol exposure and drinking quantity. Overall, after partialling out effects from other socio-demographic correlates, females were significantly more likely to endorse criteria of more/larger, time, and health problem than males. Younger adolescents had

significantly greater rates of tolerance, withdrawal, time, and alcohol dependence diagnosis than older (i.e., 18-21 years old) youth. Compared to Non-Hispanic White youth, Native Americans/Alaska natives were considerably more likely to experience withdrawal and cut down symptoms (odds ratio = 3.60 and 2.15); non-Hispanic Blacks were more likely to experience withdrawal (odds ratio = 1.85); and Asians/Pacific Islanders were almost two times more likely (odds ratio = 1.88) to report unsuccessful efforts to quit or cut down. Additionally, compared to adolescents who did not use other substances besides alcohol in the past year, adolescents reporting use of other substances in the past year were significantly more likely to report alcohol dependence symptoms (odds ratios ranged from 1.35 to 2.34) and two times more likely to meet alcohol dependence diagnosis. There were no significant differences found for family income.

Significant two-way interactions were found for some of the alcohol dependence criteria. The two-way interaction between age group and alcohol exposure (combining the two heaviest categories of drinking frequency) was significant for tolerance ( $\chi^2 = 10.97, p = .01$ ) and overall alcohol dependence diagnosis ( $\chi^2 = 7.94, p < .05$ ) (Figure 2). Compared to older adolescents, younger adolescents showed a more rapid increase in the probability of experiencing tolerance and alcohol dependence for up to 4-5 drinking days per month, but leveled off at higher levels. By comparison, older adolescents showed a smaller increase in the probability of experiencing tolerance and alcohol dependence for up to 4-5 drinking days, but showed a steeper increase between 4-5 drinking days and 6 or more drinking days. Finally, there were significant interactions between other substance use and recent alcohol exposure for tolerance ( $\chi^2 = 13.08, p < .01$ ) and unsuccessful attempts to quit or cut down ( $\chi^2 = 14.64, p < .01$ ) (Figure 3). Adolescents reporting having used other substances in the past year showed a consistent rate of increase in the probability of experiencing tolerance for increasing rates of alcohol exposure, whereas adolescents who did not use other substances showed a slightly less steep increase for the lower levels of exposure (up to 5 drinking days) and a slightly steeper increase between 4-5 drinking days and 6 or more drinking days. The opposite was found for the probability of unsuccessful efforts to quit or cut down, which increased steadily at all levels of alcohol exposure for those who did not use other substances, but leveled off for those who did use other substances for levels of exposure beyond 4-5 drinking days. The two-way interaction between ethnicity and alcohol exposure and between gender and alcohol exposure did not reach statistical significance for any symptoms, suggesting that the increase in the probability of symptom endorsement and alcohol dependence in these groups was consistent across the range of alcohol exposure.

## 4. Discussion

### 4.1. Recent Alcohol Exposure and Alcohol Dependence

The present study examined the endorsement of alcohol dependence criteria as well as diagnosis among adolescent recent onset drinkers. A few major findings emerged. First, alcohol dependence symptoms were experienced by a substantial proportion of the population even at lower levels of drinking (e.g. only a few drinking days per month). Rates for endorsing symptoms were highest for unsuccessful efforts to quit or cut down, tolerance, and time spent on alcohol use. The rate of endorsement of the criterion of using a larger amount over a longer period than intended was the lowest across levels of drinking in this study. These findings are consistent with previous research, which has shown that some symptoms, particularly tolerance, emerge early and are experienced by many adolescent drinkers (Hartford, et al., 2005; Martin, Langenbucher, Kaczynski, & Chung, 1996). Most notably, in this study, more than 20% of adolescents who reported drinking only 1 day a month reported having experienced unsuccessful efforts to quit or cut down on their alcohol use. This rate is significantly higher than rates of approximately 3% and 6% found in previous research for current (drinking within the past 12 months) and heavier drinkers

(drinking 5 or more drinks on one occasion in the past 30 days), respectively (see Hartford et al., 2005). Although the lower rates were found in a nationally representative sample of adolescents, unlike the current study, it included adolescents who reported drinking in the past 12 months regardless of age of onset. Thus, it represented a wider range of alcohol exposure than the current sample. Additionally, the current items measuring cut down (Table 2) had a lower threshold of endorsement (i.e. at least a one-time desire to cut down) compared to other measures of this symptom which specify a persistent desire to cut down or unsuccessful efforts to do so. This may contribute to the higher endorsement of this symptom observed in this study. An inability to quit or cut down on alcohol use can be thought of as a marker of “impaired control” (Hartford et al., 2005) similar to loss of control which has been found to be an early emerging nicotine dependence symptom (DiFranza et al., 2007; DiFranza et al., 2002; DiFranza et al., 2000; Gervais, O’Loughlin, & Meshefedjian, 2006) experienced by adolescent recent onset smokers at very low levels of smoking exposure (Rose, Dierker, & Donny, 2010). The present sample was drawn from a unique population of novice young drinkers. Consequently, alcohol dependence symptoms may differ in populations with a more extensive history of alcohol use or a wider variety of alcohol use patterns. Additionally, it is possible that the population of interest in this study included a higher proportion of individuals who rapidly escalate (i.e. from first drink to regular use within one year) than is present in the general population. The present findings are generalizable to recent-onset adolescent drinkers, and provide information about alcohol dependence symptoms which may be relevant for developing early intervention in this population.

In general, significant linear and quadratic trends indicated that rates of symptom endorsement increased steadily, particularly between the low to moderate levels of recent alcohol exposure. This is consistent with previous research on alcohol use in adults that showed that risk for dependence appears to increase more rapidly between lower levels of daily drinking, but levels off at heavier levels (Caetano et al., 1997). Even more interesting is that the trend in symptom endorsement across levels of alcohol exposure for recent onset adolescent drinkers is remarkably similar to trends found for recent onset adolescent cigarette smokers (Rose et al., 2010). For both substances, recent onset users appear to experience symptoms at low levels of use and there is a rapid increase in prevalence rates between lower levels of exposure than between higher levels of exposure. This suggests that, despite eliciting very different physiological responses (i.e. depressant vs. stimulant), the development of alcohol and nicotine dependence is similar in recent onset users. That is, for both substances, adolescents appear to be at risk for the development of dependence symptoms soon after beginning substance use and at very low levels of use. Thus, for some recent onset adolescent drinkers, what might appear to be benign experimentation may in fact put them at much greater risk for developing dependence.

#### 4.2. Socio-demographic Characteristics and Alcohol Dependence

Findings from present studies showed important variations in symptom endorsement or diagnosis related to gender, age group, ethnicity, and substance use, in addition to recent alcohol exposure. To our knowledge, this is the first study that has examined the relations between socio-demographic background and alcohol dependence among recent onset adolescent drinkers.

After controlling for alcohol quantity, past year alcohol use and other demographic characteristics, young, early-onset adolescent drinkers were more likely to endorse symptoms of tolerance and withdrawal and to meet criteria for a dependence diagnosis. Furthermore, younger adolescents experienced more rapid increases in the likelihood of experiencing tolerance and a dependence diagnosis at lower levels of alcohol exposure than did older adolescents. This supports previous research suggesting that those who began

drinking at a young age are more likely to develop alcohol dependence symptoms (Deas, Riggs, Langenbucher, Goldman, & Brown, 2000; Floy, Lynam, Milich, Leukefeld, & Clayton, 2004). Similarly, the lower endorsement among the older adolescent group reported in the current study are consistent with previous findings that late-onset drinkers (here, age of onset >17) are less likely to be alcohol dependent (Floy, Lynam, Milich, Leukefeld, & Clayton, 2004).

Females were more likely to be alcohol dependent, to use alcohol in larger amounts for a longer period than intended and to report drinking despite physical or psychological problems related to their alcohol use. Compared to non-Hispanic White youth, native American/Alaska natives were more likely to experience withdrawal and to report unsuccessful attempts to quit or cut down, whereas Asians/Pacific Islander were more likely to endorse tolerance symptoms. Taken together, these results may suggest that younger adolescents, females, Native American/Alaskans and Asian/Pacific Islanders may experience dependence symptoms or develop dependence more quickly after beginning to drink and, for younger adolescents, at lower levels of use.

Notably, the gender and ethnicity differences found in this study were not consistent with previous research that indicates that alcohol dependence rates are higher in males than female late adolescents (i.e., age 18-23 years old) and in non-Hispanic White adolescents and older adolescents (see Windle & Windle, 2005). These differences between the findings from the present study and previous study might largely be based on differences in amount and length of alcohol exposure in the two studies. Unlike other previous research in which rates of dependence were examined in individuals who varied in their amount and length of alcohol exposure, this study examined dependence symptoms at different levels of alcohol exposure among adolescents who had just begun drinking in the past year, controlling for quantity of drinking. Differences, then, might be related to the number of years adolescents had been drinking in other studies and the fact that this study controlled for drinking quantity. In terms of gender differences, this is supported by longitudinal research that indicates that rates of dependence are similar among younger males and females (ages 12-17), but five years later, males have higher rates of dependence than females (Palmer et al., 2009), a pattern attributed to heavier drinking among males (Windle & Windle, 2005). Likewise, Non-Hispanic Whites adolescents also have been found to drink more heavily (Windle & Windle, 2005). Thus, the higher rates of dependence typically found in males and Non-Hispanic Whites could be attributed to heavier drinking while our results suggest that younger females, Native American/Alaskans and Asian/Pacific Islanders may be more likely to develop alcohol dependence independent of how heavily they drink. More research is needed, however, to better understand the role of drinking quantity and length of exposure on demographic differences in the development of alcohol dependence symptoms.

The current study has a number of strengths. First, it involved a large, nationally representative data set, which allowed us to examine alcohol dependence symptoms and diagnosis over a more diverse range of drinking levels among recent onset adolescent drinkers. The large sample of drinkers permitted an examination of dependence symptoms along the full continuum of drinking frequency while controlling for drinking quantity. We chose drinking frequency as the primary measure of alcohol exposure instead of drinking quantity because increasing drinking frequency may play a greater role in the development of substance use dependence, where greater dependence is manifested by shorter and shorter periods between exposure. Another way to possibly categorize alcohol exposure would be to create a global quantity by frequency score and either create groups from this variable or analyze it as a continuous exposure variable. This approach, however, would not allow an examination of drinking frequency independent of quantity, as we were able to do in the present study by categorizing frequency and controlling for quantity. Furthermore, increases



in a global frequency\quantity measure might not necessarily reflect increases in severity along a continuum of alcohol exposure. That is, the number of drinks determined by the product of drinking frequency and quantity considers adolescents who might drink occasionally, but very heavily when they do drink, the same as adolescents who might drink lesser amounts of alcohol more frequently. The large sample also allowed us to focus on adolescents who had begun drinking in the past year, which alleviates the potential influence of length of alcohol exposure on alcohol dependence symptoms and reduces the potential confounding effect of past drinking behavior on symptom endorsement. Finally, we examined potential differences in the relation between alcohol exposure and alcohol dependence symptoms as a function of socio-demographic characteristics. As our research shows, there is considerable heterogeneity in prevalence rates for alcohol dependence symptoms among individuals who have been drinking for a similar amount of time.

Despite the numerous strengths of this study, there are some limitations that should be noted. The measures were self-report and required retrospective recall of past year behaviors, which could be affected by inaccuracy or socially desirable responding. Future studies could apply triangulation of reporters to eliminate some of the possible bias when using self-report measures. The cross-sectional nature of our data cannot inform us about the direction of the relation between recent alcohol exposure and endorsement of alcohol dependence symptoms. It could be that higher levels of drinking resulted in increased likelihood of experiencing dependence symptoms, or it could be that emerging dependence symptoms lead to increasing levels of drinking. Accordingly, further longitudinal research is recommended in order to rigorously evaluate the hypothesis that early-emerging dependence symptoms lead to more excessive alcohol use. If this hypothesis were supported, it would suggest a novel approach for targeted prevention efforts. Finally, we did not examine other risk factors, such as family history of drinking that could affect the development of dependence symptoms in adolescents. An examination of ROC curves for each dependence criterion and for diagnosis of alcohol dependence was moderate, indicating that there are other factors in addition to reported alcohol exposure that contribute to the likelihood of symptom endorsement and alcohol dependence. This study demonstrates that more research is needed to better understand the development of alcohol dependence symptoms in adolescents who have recently begun drinking.

## 5. Conclusion

This study identified important differences in the rates of alcohol dependence symptoms in adolescent recent onset drinkers across a full continuum of alcohol exposure ranging from infrequent (drinking 1 day per month) to more frequent (drinking more than 10 days per month) drinking, after controlling for drinking quantity and past year alcohol use. Some recent onset adolescent drinkers who drink infrequently experience alcohol dependence symptoms, and this may be particularly true for younger adolescents and for those who use other illicit substances. The experience of alcohol dependence symptoms at low levels of use has also been found for nicotine dependence symptoms in recent onset smokers (Rose & Dierker, 2010; Rose et al., 2010). As with cigarette smoking, there is widespread belief among adolescents that only those who drink heavily for a long period of time are at risk for dependence and that they, themselves, are generally invulnerable to this risk if they drink only occasionally. Thus, prevention and early intervention efforts that address these beliefs and teach adolescents to recognize the early symptoms of alcohol dependence may help to reduce the likelihood that adolescents will experiment with, or continue to drink, alcohol.

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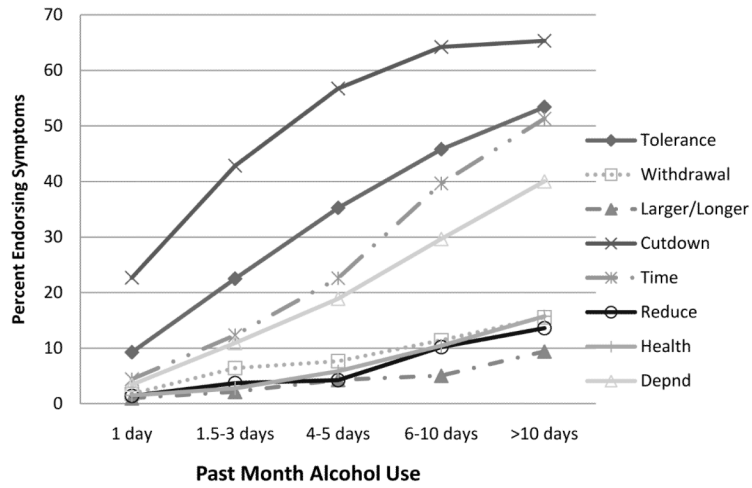
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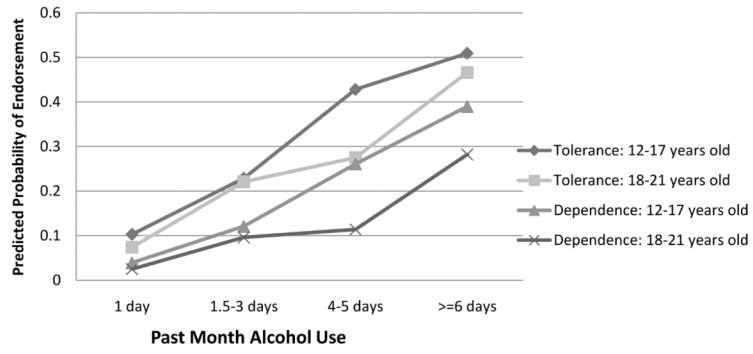
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### Research Highlights

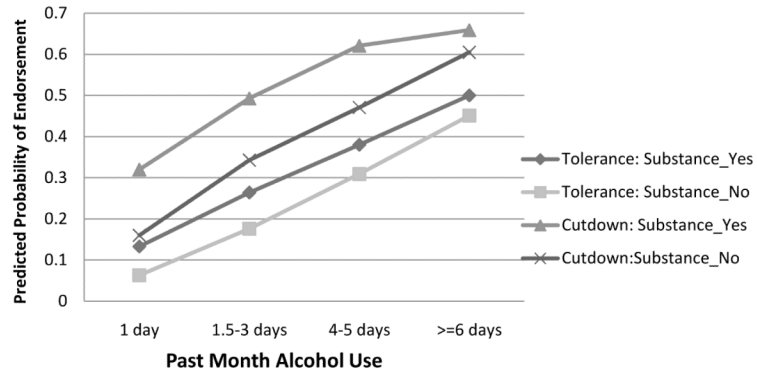
- Among recent onset adolescent drinkers, the most prevalent DSM-IV alcohol dependence criteria at low levels of alcohol use were unsuccessful efforts to “cut down”, “tolerance”, and “time” spent in activities necessary to obtain alcohol or recover from its effect.
- Logistic regression with polynomial contrasts indicated increasing rates of each criterion and an overall dependence diagnosis with increasing alcohol exposure that differed most between the lowest levels of recent alcohol exposure
- After controlling for drinking quantity, younger adolescents, females, Native American/Alaskans and Asian/Pacific Islanders were most likely to experience alcohol dependence symptoms and dependence shortly after beginning to drink
- Recognizing early symptoms of alcohol dependence may assist in early identification and intervention of those at risk for heavier drinker in the future



**Fig. 1.** Association between levels of recent alcohol exposure and DSM-IV dependence criteria and diagnosis.



**Fig. 2.** Symptom endorsement of tolerance and dependence as a function of drinking frequency and age group.



**Fig. 3.** Symptom endorsement of tolerance and cut down as a function of drinking frequency and substance use.

**Table 1**

Sample Characteristics (N = 9,490)

Variable	N ( design adjusted %) for categorical data; M (SE) for continuous data	
	Recent-onset Drinkers	Experienced Current Drinkers
Gender		
Female	5,066 (52.7%)	21,256 (46.1%)
Male	4,424 (47.3%)	23,028 (53.9%)
Age		
12-17 years	6,007 (56.5%)	13,094 (23.9%)
18-21 years	3,483 (43.5%)	31,190 (76.1%)
Ethnicity		
Hispanic	1,319 (15.6%)	5,939 (14.2%)
Non-Hispanic Black	1,129 (12.5%)	3,780 (9.0%)
Native Am <sup>a</sup>	128 (0.5%)	615 (0.6%)
Non-Hispanic Asian/Pac Isl <sup>b</sup>	292 (4.0%)	1,073 (2.9%)
Non Hispanic Interracial	273 (1.3%)	1,287 (1.39%)
Non-Hispanic White	6,349 (66.1%)	31,590 (71.92%)
Family income		
Less than \$20,000	2,293 (23.3%)	14,123 (30.96%)
\$20,000-\$49,999	2,858 (28.9%)	13,712 (29.61%)
\$50,000-\$74,999	1,656 (16.9%)	6,607 (14.66%)
\$75,000 or more	2,683 (30.9%)	9842 (24.77%)
Substance use <sup>c</sup> in past year:		
Yes	5,333 (56.0%)	34,561 (77.99%)
No	4,157 (44.0%)	9,723 (22.01%)
Past Month Alcohol use		
1 day	3,336 (34.4%)	5,955 (12.8%)
1.5-3 days	3,302 (34.9%)	11,986 (26.5%)
3.5-5 days	1,389 (15.0%)	7,969 (18.0%)
6-10 days	949 (10.0%)	9,256 (21.4%)
>10 days	514 (5.7%)	9,118 (21.3%)
Past year alcohol use	33.73 (0.74)	87.27 (0.56)
Number of drinks per day last month	3.56 (0.05)	5.06 (0.03)

<sup>a</sup>Native Am =Native Americans/Alaska Native<sup>b</sup>Pac Isl= Pacific Islander<sup>c</sup>Substance use here is either illicit drug uses (i.e., Hallucinogens, Heroin, Marijuana, Cocaine, Inhalant, Sedatives, Tranquilizers, Stimulants, or Analgesics) or cigarette use.



**Table 2**

## Mapping alcohol dependence symptoms with DSM-IV criterion

Criterion	Item
1. Tolerance: either (a) a need for markedly increased amount of the substance to achieve intoxication or the desired effect or (b) markedly diminished effect with continued use of the same amount of the substance.	<p>During the past 12 months</p> <ul style="list-style-type: none"> <li>• Did you need to drink more alcohol than you used to in order to get the effect you want?</li> <li>• Did you notice that drinking the same amount of alcohol had less effect on you than it used to?</li> </ul>
2. Withdrawal: either (a) the characteristic withdrawal syndrome for the substance or (b) the same (or closely related) substance is taken to relieve or avoid withdrawal symptoms	<p>During the past 12 months</p> <ul style="list-style-type: none"> <li>• Did you have 2 or more of these symptoms after you after you cut back or stopped drinking alcohol?</li> <li>• Did you have 2 or more of these symptoms at the same time that lasted for longer than a day after you cut back or stopped drinking alcohol? <ul style="list-style-type: none"> <li>- Sweating or feeling that your heart was beating fast</li> <li>- Having your hands tremble</li> <li>- Having trouble sleeping</li> <li>- Vomiting or feeling nauseous</li> <li>- Seeing, hearing, or feeling things that weren't really there</li> <li>- Feeling like you couldn't sit still</li> <li>- Feeling anxious</li> <li>- Having seizures or fits</li> </ul> </li> </ul>
3. The substance is often taken in larger amounts or over a longer period than intended	<p>During the past 12 months,</p> <ul style="list-style-type: none"> <li>• Were you able to keep the limits you set, or did you often drink more than you intended to?</li> </ul>
4. There is a persistent desire or unsuccessful efforts to cut down or control substance use	<p>During the past 12 months,</p> <ul style="list-style-type: none"> <li>• Did you want to or try to cut down or stop drinking alcohol?</li> <li>• Were you able to cut down or stop drinking alcohol every time you wanted to or tried to? [Reverse coded]</li> <li>• Did you cut down or stop drinking at least one time?</li> </ul>
5. A great deal of time is spent in activities necessary to obtain the substance, use the substance, or recover from its effect	<p>During the past 12 months</p> <ul style="list-style-type: none"> <li>• Was there a month or more when you spent a lot of your time getting or drinking alcohol?</li> <li>• Was there a month or more when you spent a lot of time getting over the effects of the alcohol you drank?</li> </ul>
6. Important social, occupational, or recreational activities are given up or reduced because of substance use?	<p>During the past 12 months,</p> <ul style="list-style-type: none"> <li>• Did drinking alcohol cause you to give up or spend less time doing these types of important activities? <ul style="list-style-type: none"> <li>- Working</li> <li>- Going to school</li> <li>- Taking care of children</li> <li>- Doing fun things as hobbies and sports</li> <li>- Spending time with friends and family</li> </ul> </li> </ul>
7. The substance use is continued despite knowledge of having a	<p>During the past 12 months,</p>

Criterion	Item
persistent physical or psychological problem that is likely to have been caused or exacerbated by the substance?	<ul style="list-style-type: none"><li data-bbox="610 254 1365 296">• Did you continue to drink alcohol even though you thought drinking was causing you to have problem with your emotions, nerves, or mental health?</li><li data-bbox="610 306 1365 352">• Did you continue to drink even though you thought drinking was causing you to have physical problems</li></ul>

**Table 3**  
Logistic Regression of Alcohol Dependence as a Function of Level of Past Month Alcohol Use

	Tolerance		Withdrawal		Lager/Longer		Cut Down		Time		Reduce		Health		Depend	
	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)
Recent alcohol exposure																
1.5-3 days	2.43 <sup>a</sup>	(2.02-2.92)	3.47 <sup>a</sup>	(2.38-5.05)	2.00	(1.22-3.27)	2.20 <sup>a</sup>	(1.91-2.53)	2.52 <sup>a</sup>	(1.87-3.39)	2.35 <sup>a</sup>	(1.43-3.89)	1.68	(1.05-2.67)	2.97 <sup>a</sup>	(2.27-3.89)
4-5 days	3.90 <sup>a</sup>	(3.16-4.81)	3.80 <sup>a</sup>	(2.65-5.45)	3.69 <sup>a</sup>	(2.10-6.47)	3.33 <sup>a</sup>	(2.78-3.99)	4.36 <sup>a</sup>	(3.25-5.86)	2.34 <sup>a</sup>	(1.42-3.83)	3.26 <sup>a</sup>	(2.04-5.20)	4.86 <sup>a</sup>	(3.66-6.46)
6-10 days	4.75 <sup>a</sup>	(3.68-6.14)	5.05 <sup>a</sup>	(3.16-8.05)	3.75 <sup>a</sup>	(2.18-6.45)	3.53 <sup>a</sup>	(2.77-4.50)	7.71 <sup>a</sup>	(5.42-10.96)	4.88 <sup>a</sup>	(2.84-8.38)	5.18 <sup>a</sup>	(3.04-8.82)	7.01 <sup>a</sup>	(5.13-9.56)
> 10 days	5.15 <sup>a</sup>	(3.77-7.05)	6.21 <sup>a</sup>	(3.73-10.34)	6.56 <sup>a</sup>	(3.42-12.59)	2.80 <sup>a</sup>	(1.95-4.03)	9.92 <sup>a</sup>	(6.83-14.40)	5.67 <sup>a</sup>	(3.13-10.27)	7.16 <sup>a</sup>	(4.14-12.39)	9.06 <sup>a</sup>	(6.27-13.07)
# of drinks per day last month																
Past year alcohol use	1.07 <sup>a</sup>	(1.06-1.09)	1.03	(1.00-1.06)	1.06 <sup>a</sup>	(1.03-1.09)	1.03 <sup>a</sup>	(1.02-1.05)	1.09 <sup>a</sup>	(1.07-1.12)	1.06 <sup>a</sup>	(1.04-1.09)	1.04 <sup>a</sup>	(1.02-1.07)	1.06 <sup>a</sup>	(1.04-1.08)
AUC	.758		.700		.744		.746		.809		.766		.760		.777	

<sup>a</sup>Note. Significant using the Benjamini-Hochberg procedure for Type I error rate adjustment for multiple tests (Benjamini & Hochberg, 1995). Reference group for alcohol use is the lowest level of alcohol use, which is "1 day". OR = Odds ratio.

**Table 4**  
 Logistic Regression with Polynomial Contrasts of Alcohol Dependence as a Function of Level of Past Month Alcohol Use

	Linear		Quad		Cubic	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
Tolerance	0.96 <sup>***</sup>	0.12	-0.87 <sup>***</sup>	0.09	0.39 <sup>***</sup>	0.07
Withdrawal	1.01 <sup>***</sup>	0.19	-0.80 <sup>***</sup>	0.16	0.49 <sup>***</sup>	0.12
More	1.22 <sup>***</sup>	0.23	-0.63 <sup>**</sup>	0.18	0.42 <sup>*</sup>	0.18
Cut Down	0.49 <sup>**</sup>	0.15	-0.81 <sup>***</sup>	0.10	0.39 <sup>***</sup>	0.07
Time	1.50 <sup>***</sup>	0.13	-1.03 <sup>***</sup>	0.12	0.24 <sup>**</sup>	0.09
Reduce	1.13 <sup>***</sup>	0.21	-0.71 <sup>***</sup>	0.18	0.07	0.17
Health	1.38 <sup>***</sup>	0.18	-0.82 <sup>***</sup>	0.17	0.11	0.16
Depend	1.35 <sup>***</sup>	0.14	-0.10 <sup>***</sup>	0.10	0.42 <sup>***</sup>	0.09

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .001$ .

**Table 5**  
 Logistic Regression of Alcohol Dependence as a Function of Sociodemographic Characteristics while Controlling the Levels of Past Month Alcohol Use

	Tolerance		Withdrawal		Lager/Longer		Cut Down		Time		Reduce		Health		Dependent	
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Recent alcohol exposure																
1-5-3 days	2.39 <sup>a</sup> (1.99-2.88)	3.38 <sup>a</sup> (2.33-4.89)	1.82 (1.11-3.00)	2.10 <sup>a</sup> (1.82-2.43)	2.42 <sup>a</sup> (1.80-3.24)	2.19 <sup>a</sup> (1.33-3.60)	1.59(1.01-2.50)	2.86 <sup>a</sup> (2.18-3.76)								
4-5 days	3.83 <sup>a</sup> (3.10-4.72)	3.59 <sup>a</sup> (2.48-5.21)	3.20 <sup>a</sup> (1.77-5.79)	3.10 <sup>a</sup> (2.58-3.73)	4.15 <sup>a</sup> (3.09-5.58)	2.03 <sup>a</sup> (1.24-3.30)	3.03 <sup>a</sup> (1.90-4.84)	4.59 <sup>a</sup> (3.43-6.14)								
6-10 days	4.61 <sup>a</sup> (3.59-5.93)	5.08 <sup>a</sup> (3.17-8.15)	3.23 <sup>a</sup> (1.84-5.68)	3.25 <sup>a</sup> (2.54-4.16)	7.56 <sup>a</sup> (5.27-10.84)	4.33 <sup>a</sup> (2.52-7.46)	4.89 <sup>a</sup> (2.93-8.17)	6.77 <sup>a</sup> (4.89-9.37)								
>10 days	4.95 <sup>a</sup> (3.64-6.73)	5.99 <sup>a</sup> (3.61-9.93)	5.57 <sup>a</sup> (2.87-10.81)	2.51 <sup>a</sup> (1.76-3.59)	9.78 <sup>a</sup> (6.70-14.29)	4.75 <sup>a</sup> (2.62-8.63)	6.81 <sup>a</sup> (3.95-11.71)	8.61 <sup>a</sup> (5.92-12.53)								
# of drinks per day last month																
Past year alcohol use	1.07 <sup>a</sup> (1.05-1.09)	1.03(1.00-1.06)	1.06 <sup>a</sup> (1.03-1.09)	1.02 <sup>a</sup> (1.01-1.04)	1.09 <sup>a</sup> (1.07-1.11)	1.06 <sup>a</sup> (1.03-1.09)	1.04 <sup>a</sup> (1.01-1.07)	1.06 <sup>a</sup> (1.03-1.08)								
Gender	1.01 <sup>a</sup> (1.01-1.01)	1.00 <sup>a</sup> (1.00-1.01)	1.00(1.00-1.00)	1.01 <sup>a</sup> (1.01-1.01)	1.01 <sup>a</sup> (1.01-1.01)	1.00 <sup>a</sup> (1.00-1.01)	1.00 <sup>a</sup> (1.00-1.01)	1.01 <sup>a</sup> (1.00-1.01)								
Female	0.86(0.75-0.99)	1.34(1.03-1.74)	1.55 <sup>a</sup> (1.18-2.05)	0.96(0.85-1.08)	1.63 <sup>a</sup> (1.39-1.91)	1.20(0.90-1.60)	1.66 <sup>a</sup> (1.27-2.16)	1.30 <sup>a</sup> (1.10-1.53)								
Age Group	1.24 <sup>a</sup> (1.05-1.46)	1.80 <sup>a</sup> (1.32-2.45)	1.17(0.82-1.68)	1.06(0.93-1.21)	1.32 <sup>a</sup> (1.08-1.61)	1.44(1.02-2.01)	1.15(0.85-1.54)	1.44 <sup>a</sup> (1.17-1.79)								
Ethnicity	1.03(0.83-1.28)	1.52(1.09-2.11)	1.16(0.77-1.77)	1.20(1.01-1.43)	0.90(0.70-1.15)	1.45(0.99-2.13)	0.62(0.40-0.97)	1.18(0.93-1.51)								
Hispanic	0.99(0.79-1.23)	1.85 <sup>a</sup> (1.30-2.63)	0.76(0.44-1.31)	1.12(0.93-1.35)	0.80(0.60-1.06)	0.92(0.49-1.75)	0.86(0.53-1.41)	1.05(0.78-1.42)								
Black	0.92(0.46-1.84)	3.60 <sup>a</sup> (1.37-9.48)	2.03(0.97-4.24)	2.15 <sup>a</sup> (1.40-3.30)	1.66(0.72-3.85)	2.01(0.87-4.65)	2.40(0.81-7.18)	2.34(0.89-6.18)								
Native American	1.77 <sup>a</sup> (1.28-2.44)	2.22(1.12-4.39)	1.00(0.36-2.78)	0.99(0.64-1.53)	1.08(0.74-1.57)	2.17(1.02-4.58)	1.23(0.59-2.59)	1.39(0.84-2.32)								
Asian	0.63(0.34-1.19)	0.82(0.34-1.96)	0.64(0.18-2.29)	1.88 <sup>a</sup> (1.18-2.99)	1.31(0.67-2.58)	0.44(0.18-1.07)	1.35(0.60-3.03)	0.84(0.46-1.52)								
Interracial	0.84(0.69-1.02)	0.98(0.68-1.39)	1.52(0.98-2.36)	1.08(0.92-1.27)	0.85(0.65-1.10)	1.47(0.99-2.18)	0.69(0.46-1.05)	0.85(0.66-1.09)								
Income	0.80(0.67-0.96)	0.83(0.59-1.17)	1.05(0.70-1.58)	1.00(0.85-1.18)	0.74(0.58-0.94)	1.05(0.73-1.51)	0.95(0.66-1.37)	0.83(0.65-1.05)								
< 20K	0.78(0.63-0.98)	0.79(0.52-1.19)	0.74(0.41-1.30)	0.93(0.77-1.12)	0.93(0.72-1.20)	1.15(0.77-1.73)	1.04(0.69-1.58)	0.81(0.62-1.06)								
20K to 49,999																
50K to 74,999																
Substance Use	1.35 <sup>a</sup> (1.16-1.57)	1.85 <sup>a</sup> (1.34-2.55)	2.01 <sup>a</sup> (1.28-3.17)	1.70 <sup>a</sup> (1.50-1.94)	2.11 <sup>a</sup> (1.71-2.60)	2.34 <sup>a</sup> (1.58-3.47)	2.10 <sup>a</sup> (1.53-2.89)	2.01 <sup>a</sup> (1.60-2.52)								
Yes																

Note. OR= Odds ratio.

<sup>a</sup> Significant using the Benjamini-Hochberg procedure for Type I error rate adjustment for multiple tests (Benjamini and Hochberg, 1995). Reference group for alcohol uses in past month is “1 day”, age is “18-21 years”, for ethnicity is “White”, for family income is “75K+”, for substance use is “No”