Published in final edited form as:

Addict Behav. 2019 May ; 92: 199–202. doi:10.1016/j.addbeh.2019.01.003.

Faster Escalation from First Drink to First Intoxication as a Risk Factor for Binge and High-intensity Drinking among Adolescents

Megan E. Patrick^a, Rebecca Evans-Polce^b, and Yvonne M. Terry-McElrath^c

^aInstitute for Translational Research in Children's Mental Health & Institute of Child Development, University of Minnesota, 1100 Washington Ave S., Suite 101, Minneapolis, MN 55415 USA

^bCenter for the Study of Drugs, Alcohol, Smoking and Health, School of Nursing, University of Michigan, 426 N. Ingalls St., Ann Arbor, MI 48109 USA

^cInstitute for Social Research, University of Michigan, PO Box 1248, Ann Arbor, MI 48106, USA

Abstract

Introduction: Age of first drink is a key risk factor for adolescent high-risk alcohol use. The current study examined whether speed of escalation from first drink to first intoxication is an additional risk factor, and whether these two factors are associated with binge and high-intensity drinking among adolescents.

Methods.—Data collected in 2005–2017 from a nationally-representative sample of 11,100 U.S. 12th grade students participating in the Monitoring the Future study were coded to indicate grade of first drink, grade of first intoxication, and speed of escalation from first drink to first intoxication. Logistic regression models estimated bivariate and multivariable odds of past 2-week binge (5+ drinks in a row) and high-intensity (10+ drinks in a row) drinking in 12th grade.

Results.—Of those who reported intoxication by 12th grade, almost 60% reported first drunkenness in the same grade in which they first drank. The likelihoods of 12th grade binge and high-intensity drinking were significantly associated with both grade of first drink and speed of escalation to intoxication. Past two-week high-intensity drinking prevalence was 17.4% among those with immediate (same-grade) escalation from first drink to first intoxication; 15.8% among those with a 1-grade delay, and 12.6% among those with a 2+ grade delay to intoxication.

Conclusions.—The majority of students escalate quickly from having their first drink to being intoxicated for the first time. Both earlier age of first drink and a faster escalation from first drink

Correspondence to: Megan E. Patrick.

Contributors

ME Patrick led the manuscript including concept, interpretation of data, and manuscript preparation. R Evans-Polce conducted the data analysis and contributed to interpretation and manuscript preparation. YM Terry-McElrath contributed to interpretation of results and manuscript preparation. All authors have approved the final manuscript.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Conflict of Interest

All authors declare that they have no conflicts of interest.

to first intoxication are important indicators of binge and high-intensity drinking risk among adolescents.

Keywords

alcohol; onset; initiation; drunk; extreme binge drinking; heavy episodic drinking

1. Introduction

Early initiation of alcohol use is a risk factor for later alcohol use, heavy drinking, and adverse alcohol-related outcomes (Kuntsche et al., 2016). Questions have been raised about how alcohol use progresses, and whether early use alone or fast escalation from first drink to first intoxication is associated with negative outcomes (Enstad et al., 2017; Kuntsche et al., 2016). The length of time elapsing between alcohol use initiation and first occurrence of drinking to intoxication—labeled *speed of escalation to intoxication*—has been associated with alcohol use in one longitudinal study of college students (Morean et al., 2012) and cross-sectional studies of regional high schoolers (Morean et al., 2014; Morean et al., 2018). For example, Connecticut high school students averaged three years from first sip of alcohol to first intoxication, and 7 months from first drink to first intoxication; faster escalation to intoxication was associated with higher frequency of binge drinking (i.e., five or more drinks) (Morean et al., 2014; Morean et al., 2018). Questions about the relative importance of age at first drink and speed of escalation to intoxication remain, including whether results replicate in nationally-representative samples and the extent to which they are associated with other high-risk alcohol use behaviors.

Faster escalation to intoxication may indicate increased risk of not only binge drinking but also high-intensity drinking (sometimes called extreme binge drinking; Patrick et al., 2013), defined as drinking at twice the typical binge threshold (i.e., having at least 10 drinks at a single occasion; Patrick, 2016). In the U.S., approximately 1% of 8th graders, 4% of 10th graders, and 6% of 12th graders report high-intensity drinking (Miech et al., 2018; Patrick et al., 2017a). During adolescence (Patrick et al., 2013; Patrick et al., 2017a) and young adulthood (Patrick et al., 2016), high-intensity drinking is an important indicator of heavy alcohol use that reflects consuming alcohol in quantities associated with severe (and even life-threatening) impairment (National Institute on Alcohol Abuse and Alcoholism, 2015), and is associated with more frequent binge drinking (Patrick et al., 2016).

The current study used retrospective data from national samples of U.S. 12th graders to examine (1) typical speed of escalation from first drink to first intoxication among those reporting intoxication by 12th grade, and (2) whether speed of escalation from first drink to first intoxication is an additional risk factor for binge and high-intensity drinking among those reporting intoxication by 12th grade, accounting for grade of first drink.

2. Methods

U.S. nationally-representative data from Monitoring the Future are based on annual in-school surveys of 12th grade students (Miech et al., 2018). Data for this study were from 2005-2017 and included the random one-sixth of students each year who were asked about

binge and high-intensity drinking, age of first drink, and age of first drunkenness (N=30,863). Of this sample, 67% (N=20,517) provided valid data on all variables included in analysis. Of those with valid data, 11,100 (54%) reported both a first drink and ever being intoxicated.

2.1 Measures

Respondents were asked, “When (if ever) did you FIRST do each of the following things?” a) “...Try an alcohol beverage— more than just a few sips,” and (b) “...Drink enough to feel drunk or very high.” Response categories included “Grade 6 or below,” “Grade 7,” “Grade 8,” “Grade 9 (Freshman),” “Grade 10 (Sophomore),” “Grade 11 (Junior),” and “Grade 12 (Senior).” *Grade of first drink* was treated as continuous. *Speed of escalation* from first drink to first intoxication was calculated by subtracting the grade reported for first drink from the grade reported for first drunk and coded as follows: reported first drunk and first drink in the same grade (i.e., immediate [same-grade] escalation), reported first drunk one grade after first drink (1 grade delay to intoxication), or reported first drunk two or more grades after first drink (2+ grades delay to intoxication). Students were asked, “During the last two weeks, how many times (if any) have you had [5 or more/10 or more] drinks in a row?” *Binge drinking* (5+ drinks) and *high-intensity drinking* (10+ drinks) were each dichotomized as any vs. none. Covariates previously found to be significantly associated with adolescent binge and high-intensity drinking (Patrick et al., 2013) were included in the multivariable models: gender (male vs. female); race/ethnicity (White [Reference], Black, Hispanic, Asian, and Other); parental education (at least one parent with a college degree vs. not); any past 30-day cigarette use; and any past 30-day marijuana use. Sensitivity analyses examining cases with and without complete data showed complete-case respondents were significantly more likely to be White, have parent[s] with a college degree, and report binge and high-intensity drinking, past-month cigarette use or marijuana use, and earlier grade of first drink; no differences were observed for gender.

2.2 Analysis

Analyses were conducted using SAS v9.4, using survey procedures and weights to account for the complex sample design. Descriptive analyses examined speed of escalation to intoxication. Bivariate and multivariable (simultaneously including all noted covariates) regression models estimated the likelihood of binge and high-intensity drinking based on grade of first alcohol use and speed of escalation to intoxication.

3. Results

Among adolescents reporting ever being intoxicated by 12th grade, 58.5% reported immediate (same-grade) escalation to intoxication; 23.9% reported a 1-grade delay to intoxication, and 17.6% reported 2+ grades delay to intoxication. One-third (32.8%) initiated alcohol use in 8th grade or earlier; 26.8% in 9th grade, 20.1% in 10th grade, 13.7% in 11th grade, and the remaining 6.5% in 12th grade.

Past 2-week high-intensity drinking was reported by 9.1% of all 12th graders and 16.2% of those who reported intoxication by 12th grade; respective levels of binge drinking were

18.4% and 33.9%. Among those ever intoxicated, high-intensity drinking was reported by 17.4% of those with an immediate (same-grade) escalation, 15.8% of those with a 1-grade delay, and 12.6% of those with a 2+ grade delay to intoxication. These differences were significant in bivariate models (Table 1). For example, those with same-grade escalation had more than 3 times the odds ($OR=3.01$) and those with a 1-grade delay had more than twice the odds ($OR=2.11$) of high-intensity drinking in 12th grade, compared to those with a 2+ grade delay to intoxication. Similar associations were found for binge drinking. Earlier grade of first drink was associated with increased odds of recent binge and high-intensity drinking in 12th grade (Table 1). Additional models (not shown) using only those who reported their first drink by 10th grade (to allow time for escalation) explored a possible moderation effect to see whether risk associated with faster escalation was amplified among earlier initiators; no significant interactions were observed.

After controlling for sociodemographics and other substance use, both grade of first drink and speed of escalation to intoxication remained significant predictors of binge and high-intensity drinking in 12th grade (Table 1). Adolescents with immediate (same-grade) escalation to intoxication and with 1-grade delay had higher odds of high-intensity drinking ($AOR=2.19$ and $AOR=1.73$, respectively), compared to those with a 2+ grade delay. Additional models (not shown) revealed that same-grade escalation was also associated with significantly higher odds of binge ($AOR=1.21$, 95% CI: 1.07, 1.37) and high-intensity ($AOR=1.26$, 95% CI: 1.08, 1.47) drinking than a 1-grade delay.

4. Discussion

In this nationally-representative study of U.S. students who reported intoxication by 12th grade, those who initiated alcohol use in earlier grades and escalated more quickly from first drink to first intoxication were more likely to report engaging in recent binge and high-intensity drinking as 12th graders. These effects held when both indicators were in the model, supporting the conclusion that both age of first drink and speed of escalation are independent risk factors for adolescent drinking. This extends previous evidence that speed of escalation to intoxication is an important risk factor (Kuntsche et al., 2016; Morean et al., 2012; Morean et al., 2014; Morean et al., 2018), by demonstrating the effects in a national sample and with the additional outcome of high-intensity drinking. We found a gradient in this effect such that same-grade escalation was riskiest, but a 1-grade delay conveyed greater risk than a 2+ grade delay. Interventions targeting youth most at risk for extreme and dangerous drinking may appropriately consider screening based on speed of escalation from first drink to first intoxication.

In the current study, the majority (approximately three-fifths) of 12th graders who had ever been intoxicated reported same-grade escalation from first drink to first drunk. There is little comparative data in other published studies. Monshouwer et al. (2003) found approximately one-third of Dutch adolescents reported first intoxication within one year of first drink; almost 60% reported first intoxication within two years. Progression from first drink to first drunk averaged one year among adolescents in substance use treatment (Jackson, 2010), and less than 1 year in a local high school sample (Morean et al., 2014; Morean et al., 2018). The current study's nationally-representative data provided further evidence that among 12th

graders who had ever been drunk, there was a relatively short window of time between first drink and first intoxication. Given the particularly deleterious effects of alcohol on adolescent brain development (Ewing et al., 2014; Hiller-Strumhofel and Swartzwelder, 2004/2005), swift progression across drinking “milestones” during this developmental period raises concern and highlights the importance of prevention programming prior to the first drinking experience.

As speed of escalation to intoxication accelerates, so too does progression to tolerance and alcohol use disorder (AUD) in later life (Deutsch et al., 2017). High-intensity drinking is one possible pathway from speed of escalation to later AUD. Adolescent high-intensity drinking is also associated with other substance use risk factors including drinking for coping and compulsive use reasons (Terry-McElrath et al., 2017), nonmedical use of prescription drugs (McCabe et al., 2017), marijuana use (Patrick et al., 2013; Patrick et al., 2017a), and simultaneous alcohol and marijuana use (Patrick et al., 2017b).

4.1 Limitations and Future Research

As limitations of the study, (1) the sample excludes high school dropouts who have higher alcohol use risk (Tice et al., 2017); (2) students who did not report intoxication by 12th grade were excluded (however, very few who did not report lifetime intoxication reported either binge [1.43%] or high-intensity drinking [0.31%]); (3) the timing of first use is based on school grade (to facilitate recall) so heterogeneity of biological age remains; (4) the definition of intoxication (“feel drunk or very high”) is subjective, and providing clear definitions in the future may improve inferences (Morean et al., 2018); and (5) data are based on retrospective self-reports subject to reporting error. The forward telescoping effect suggests that, especially among lower-risk drinkers, there may be an upward shift in reporting age of first drink over time (Sartor et al., 2011). Age of first drink and first drunk were reported at the same time, so any bias likely affected both reports. Future research could investigate patterns of escalation to intoxication that reach further into adulthood. However, very few people who initiate alcohol use or drunkenness after 12th grade go on to engage in binge or high-intensity drinking (Patrick and Terry-McElrath, 2017; Terry-McElrath and Patrick, 2016). Additional areas for future research include identifying the mechanisms of these effects, such as possible mediation of family history of alcohol use disorders and other risk factors. For example, a risk factor for faster escalation to first intoxication may be genetic variation in taste perceptions of alcohol (Duffy et al., 2004a; Duffy et al., 2004b; Hashimoto et al., 2013; Hayes et al., 2011).

4.2 Conclusions

These results provide evidence from nationally-representative samples of U.S. students that the majority of 12th graders reporting lifetime intoxication transition from first drink to first intoxication within one year, and that both an earlier age of first drink and a faster speed of escalation from first drink to first intoxication are important indicators of risk for binge and high-intensity drinking among adolescents.

Acknowledgments

Role of Funding Sources

Development of this manuscript was supported by research grant R01AA023504 from the National Institute on Alcohol Abuse and Alcoholism to M. Patrick. Data collection and manuscript preparation were supported by research grants R01DA001411 and R01DA016575 from the National Institute on Drug Abuse. The study sponsors had no role in the study design, collection, analysis or interpretation of the data, writing of the manuscript, or the decision to submit the paper for publication. The content is solely the responsibility of the authors and does not necessarily represent the official views of the study sponsor.

References

- Deutsch AR, Slutske WS, Lynskey MT, Bucholz KK, Madden PAF, Heath AC, Martin NG, 2017 From alcohol initiation to tolerance to problems: Discordant twin modeling of a developmental process. *Dev Psychopathol* 29, 845–861. DOI:10.1017/s0954579416000523. [PubMed: 27417028]
- Duffy VB, Davidson AC, Kidd JR, Kidd KK, Speed WC, Pakstis AJ, Reed DR, Snyder DJ, Bartoshuk LM, 2004a Bitter receptor gene (TAS2R38), 6-n-propylthiouracil (PROP) bitterness and alcohol intake. *Alcohol Clin Exp Res* 28, 1629–1637. DOI:10.1097/01.ALC.0000145789.55183.D4 [PubMed: 15547448]
- Duffy VB, Peterson JM, Bartoshuk LM, 2004b Associations between taste genetics, oral sensation and alcohol intake. *Physiol Behav* 82, 435–445. DOI:10.1016/j.physbeh.2004.04.060. [PubMed: 15276808]
- Enstad F, Pedersen W, Nilsen W, Von Soest T, 2017 Predicting early onset of intoxication versus drinking-A population-based prospective study of Norwegian adolescents. *Addict Behav Rep* 6, 1–7. DOI:10.1016/j.abrep.2017.04.002. [PubMed: 29450232]
- Ewing SW, Sakhardande A, Blakemore SJ, 2014 The effect of alcohol consumption on the adolescent brain: A systematic review of MRI and fMRI studies of alcohol-using youth. *NeuroImage Clinical* 5, 420–437. DOI:10.1016/j.nicl.2014.06.011. [PubMed: 26958467]
- Hashimoto E, Riederer PF, Hesselbrock VM, Hesselbrock MN, Mann K, Ukai W, Sohma H, Thibaut F, Schuckit MA, Saito T, 2013 Consensus paper of the WFSBP task force on biological markers: biological markers for alcoholism. *World J Biol Psychiatry* 14, 549–564. DOI: 10.3109/15622975.2013.838302. [PubMed: 24236956]
- Hayes JE, Wallace MR, Knopik VS, Herbstman DM, Bartoshuk LM, Duffy VB, 2011 Allelic variation in TAS2R bitter receptor genes associates with variation in sensations from and ingestive behaviors toward common bitter beverages in adults. *Chem Senses* 36, 311–319. DOI:10.1093/chemse/bjq132. [PubMed: 21163912]
- Hiller-Strumhöfel S, Swartzwelder HS, 2004/2005 Alcohol's effects on the adolescent brain—what can be learned from animal models. *Alcohol Research & Health* 28, 213–221.
- Jackson KM, 2010 Progression through early drinking milestones in an adolescent treatment sample. *Addiction (Abingdon, England)* 105, 438–449. DOI:10.1111/j.1360-0443.2009.02800.x.
- Kuntsche E, Rossow I, Engels R, Kuntsche S, 2016 Is 'age at first drink' a useful concept in alcohol research and prevention? We doubt that. *Addiction* 111, 957–965. DOI:10.1111/add.12980. [PubMed: 26147610]
- McCabe SE, Veliz P, Patrick ME, 2017 High-intensity drinking and nonmedical use of prescription drugs: Results from a national survey of 12th grade students. *Drug Alcohol Depend* 178, 372–379. DOI:10.1016/j.drugalcdep.2017.05.038. [PubMed: 28704765]
- Miech RA, Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE, Patrick ME Monitoring the Future national survey results on drug use, 1975-2017: Volume I, secondary school students. Ann Arbor: Institute for Social Research, University of Michigan;2018 http://monitoringthefuture.org/pubs/monographs/mtf-vol1_2017.pdf Accessed August 15, 2018.
- Monshouwer K, Smit F, De Zwart WM, Spruit I, Van Ameijden EJC, 2003 Progress from a first drink to first intoxication: age of onset, time-windows and risk factors in a Dutch national sample of secondary school students. *Journal of Substance Use* 8, 155–163. DOI: 10.1080/14659890310001600133.
- Morean ME, Corbin WR, Fromme K, 2012 Age of first use and delay to first intoxication in relation to trajectories of heavy drinking and alcohol-related problems during emerging adulthood. *Alcohol Clin Exp Res* 36, 1991–1999. DOI:10.1111/j.1530-0277.2012.01812.x. [PubMed: 22897715]

- Morean ME, Kong G, Camenga DR, Cavallo DA, Connell C, Krishnan-Sarin S, 2014 First drink to first drunk: age of onset and delay to intoxication are associated with adolescent alcohol use and binge drinking. *Alcohol Clin Exp Res* 38, 2615–2621. DOI:10.1111/acer.12526. [PubMed: 25257574]
- Morean ME, L'Insalata A, Butler ER, McKee A, Krishnan-Sarin S, 2018 Age at drinking onset, age at first intoxication, and delay to first intoxication: Assessing the concurrent validity of measures of drinking initiation with alcohol use and related problems. *Addict Behav* 79, 195–200. DOI: 10.1016/j.addbeh.2017.12.017. [PubMed: 29304425]
- National Institute on Alcohol Abuse and Alcoholism. Alcohol overdose: the dangers of drinking too much. 2015 <http://pubs.niaaa.nih.gov/publications/AlcoholOverdoseFactsheet/Overdosefact.htm>. Accessed August 15, 2018.
- Patrick ME, 2016 A call for research on high-intensity alcohol use. *Alcohol Clin Exp Res* 40, 256–259. DOI:10.1111/acer.12945. [PubMed: 26842244]
- Patrick ME, Schulenberg JE, Martz ME, Maggs JL, O'Malley PM, Johnston LD, 2013 Extreme binge drinking among 12th-grade students in the United States: prevalence and predictors. *JAMA Pediatr* 167, 1019–1025. DOI:10.1001/jamapediatrics.2013.2392. [PubMed: 24042318]
- Patrick ME, Terry-McElrath YM, 2017 High-intensity drinking by underage young adults in the United States. *Addict* 112, 82–93. DOI:10.1111/add.13556.
- Patrick ME, Terry-McElrath YM, Kloska DD, Schulenberg JE, 2016 High-intensity drinking among young adults in the United States: prevalence, frequency, and developmental change. *Alcohol Clin Exp Res* 40, 1905–1912. DOI:10.1111/acer.13164. [PubMed: 27488575]
- Patrick ME, Terry-McElrath YM, Miech RA, O'Malley PM, Schulenberg JE, Johnston LD, 2017a Current high-intensity drinking among 8th and 10th grade students in the United States. *Am J Prev Med* 53, 904–908. DOI:10.1016/j.amepre.2017.06.027. [PubMed: 28886963]
- Patrick ME, Veliz PT, Terry-McElrath YM, 2017b High-intensity and simultaneous alcohol and marijuana use among high school seniors in the U.S. *Subst Abuse* 38, 498–503. DOI: 10.1080/08897077.2017.1356421.
- Sartor CE, Bucholz KK, Nelson EC, Madden PA, Lynskey MT, Heath AC, 2011 Reporting bias in the association between age at first alcohol use and heavy episodic drinking. *Alcohol Clin Exp Res* 35, 1418–1425. DOI:10.1111/j.1530-0277.2011.01477.x. [PubMed: 21438885]
- Terry-McElrath YM, Patrick ME, 2016 Intoxication and binge and high-intensity drinking among U.S. young adults in their mid-20's. *Substance Abuse* 37, 597–605. DOI: 10.1080/08897077.2016.1178681. [PubMed: 27092592]
- Terry-McElrath YM, Stern SA, Patrick ME, 2017 Do alcohol use reasons and contexts differentiate adolescent high-intensity drinking? Data from U.S. High school seniors, 2005–2016. *Psychology of addictive behaviors : journal of the Society of Psychologists in Addictive Behaviors* 31, 775–785. DOI:10.1037/adb0000314. [PubMed: 28933869]
- Tice P, Lipari RN, Van Horn SL Substance use among 12th grade aged youths, by dropout status The CHBSQ Report. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration;2017 https://www.samhsa.gov/data/sites/default/files/report_3196/ShortReport-3196.pdf Accessed March 27, 2018.

Highlights

- The majority of 12th graders who had been drunk went from first drink to drunk in 1 year.
- Speed of escalation to intoxication is associated with binge and high-intensity drinking.
- Grade of first drink and speed of escalation are distinct risk factors.

Table 1.

Unadjusted and adjusted associations between speed of escalation from first drink to first intoxication and high-intensity and binge drinking in the past two weeks, among those who report being intoxicated by 12th grade.

	High-intensity drinking in the past two weeks				Binge drinking in the past two weeks			
	OR	(95% CI)	AOR ^a	(95% CI)	OR	(95% CI)	AOR	(95% CI)
Grade of first drink Speed of escalation from first drink to first intoxication	0.72 *	(0.70, 0.75)	0.71 *	(0.68, 0.74)	0.79 *	(0.77, 0.81)	0.76 *	(0.74, 0.79)
Immediate (same grade) escalation to intoxication	3.01 *	(2.50, 3.63)	2.19 *	(1.78, 2.70)	1.48 *	(1.31, 1.67)	2.13 *	(1.84, 2.50)
1 grade delay to intoxication	2.11 *	(1.74, 2.56)	1.73 *	(1.40, 2.15)	1.37 *	(1.20, 1.57)	1.77 *	(1.50, 2.08)
2+ grade delay to intoxication	(ref)		(ref)		(ref)		(ref)	
<u>Covariates:</u>								
Male			3.00 *	(2.60, 3.46)			1.83 *	(1.65, 2.03)
Race/ethnicity								
White			(ref)				(ref)	
Black			0.43 *	(0.29, 0.64)			0.41 *	(0.31, 0.54)
Hispanic			0.63 *	(0.51, 0.79)			0.79 *	(0.67, 0.93)
Asian			0.40 *	(0.24, 0.66)			0.70 *	(0.58, 0.85)
Other			0.80	(0.62, 1.02)			0.78	(0.57, 1.08)
Parent(s) with college degree			1.05	(0.91, 1.21)			1.23 *	(1.10, 1.36)
Past 30-day cigarette use			1.93 *	(1.67, 2.22)			1.84 *	(1.64, 2.07)
Past 30-day marijuana use			2.15 *	(1.88, 2.46)			2.14 *	(1.93, 2.37)

Notes: n= 11,100. OR = unadjusted bivariate odds ratio. AOR = adjusted odds ratio in multivariable model.

^aModels simultaneously adjusted for gender, race/ethnicity, parental education, past 30-day cigarette use, and past 30-day marijuana use.

* p<0.05.