Not Early Drinking but Early Drunkenness Is a Risk Factor for Problem Behaviors Among Adolescents from 38 European and North American Countries

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Abstract

Background—Many studies have reported that the earlier the age at first drink (AFDrink) the higher the later drinking levels and related problems. However, unless adolescents proceed into drunkenness, it is unclear why consuming small quantities at early age should lead to later problems. This study investigates the link between AFDrink and problem behaviors (smoking, cannabis use, injuries, fights, and low academic performance) among 15-year-olds who did and did not proceed into drunkenness. Among those with drunkenness experience, we tested whether AFDrink predicted problem behaviors over and above the age at first drunkenness (AFDrunk).

Methods—Multilevel structural equation models were estimated based on a sample of 44,801 alcohol-experienced 15-year-olds from 38 North American and European countries and regions who participated in the Health Behaviour in School-aged Children cross-national survey.

Results—Overall, there was a significant association between AFDrink and all 5 problem behaviors. However, this was the case only among those with drunkenness experiences but not among those never drunk. Among the former, AFDrunk was a strong predictor for all 5 problem behaviors, but time from first drink to first drunk did not predict problem behaviors.

Conclusions—Not early alcohol initiation but early drunkenness was a risk factor for various adolescent problem behaviors at the age of 15, that is, there was not consistent relationship for the time before the first drunkenness (i.e., since first drinking). Besides targeting early drinking, particular efforts are needed to impede early drunkenness to prevent associated harm in adolescence and beyond.

Keywords

Age at First Drink; Alcohol Initiation; Drunkenness; Adolescents; Cross-Cultural Study

Many studies have documented associations between an early age at first drink (AFDrink) and a variety of negative outcomes including drunkenness, dependence, alcohol-related problems in adolescence and adulthood (Dawson et al., 2008; DeWit et al., 2000; van Diemen et al., 2008; Eliasen et al., 2009; Fergusson et al., 1994; Grant and Dawson, 1997; Gruber et al., 1996; Hawkins et al., 1997; Hingson and Zha, 2009; Hingson et al., 2006; Muthén and Muthén, 2000; Palmer et al., 2010; Pitkänen et al., 2005; Rothman et al., 2008), and the use of other psychoactive substances such as nicotine, cannabis, or cocaine (van Diemen et al., 2008; Gruber et al., 1996; Komro et al., 2010; Rothman et al., 2008; Vieira et al., 2007). The same was found for other problem behaviors such as low academic performance, violence, injuries, and suicide (Buchmann et al., 2009; Fergusson et al., 1994; Gruber et al., 1996; Hingson and Zha, 2009; Hingson et al., 2000, 2009; Komro et al., 2010; McGue et al., 2001; Peleg-Oren et al., 2009; Swahn et al., 2008, 2010). The first aim of this study is to confirm these bivariate relationships between 15-year-olds from 38 North American and European countries and regions between earlier AFDrink and higher levels of problem behaviors such as tobacco smoking, cannabis use, injuries, physical fights, and low academic performance.

Interpreting this association in a causal way, some authors have argued that an early AFDrink per se is responsible for different problems in later life over and above personal and environmental risk factors (Buchmann et al., 2009; Swahn et al., 2008; Zucker, 2008). Recently, Komro and colleagues (2010) concluded that "any use of alcohol in early adolescence is associated with other high-risk behaviors and support the critical need for efforts to prevent early initiation" (p. 14). Also, Palmer and colleagues (2010) recently stressed that "it is important to consider the best way to intervene with individuals at heightened risk due to early age of drinking onset" (p. 490). Similarly, previous studies emphasized the importance of delaying the AFDrink to prevent risky drinking and alcohol-related problems in adolescence and later in life (DeWit et al., 2000; Eliasen et al., 2009; Gruber et al., 1996; Hingson and Zha, 2009; Hingson et al., 2000, 2009; Pitkänen et al., 2005; Swahn et al., 2008).

Concerning possible rationales or mechanisms explaining why an early AFDrink should have a direct impact on later problems, authors speculated that drinking small amounts of alcohol early in life may (i) provoke changes in behavioral repertoire and identity or role that alter developmental trajectories during adolescence leading to harmful drinking (Buchmann et al., 2009; Pedersen and Skrondal, 1998), (ii) narrow modes of action and weaken the ability to control drinking habits in later life (Pitkänen et al., 2005; Swahn et al., 2008), (iii) lead to greater tolerance and habituation toward alcohol (Eliasen et al., 2009), (iv) impede the development of adequate coping strategies and problem-solving skills (Buchmann et al., 2009; Swahn et al., 2008), and (v) negatively affect social relationships, connectedness, or confidence (Pedersen and Skrondal, 1998; Swahn et al., 2008). In these explanations, however, it appears that the AFDrink "is only important to the extent that

enough alcohol was consumed to generate a physiological reaction" (Warner and White, 2003, p. 2003) and not any (small) amount of alcohol consumed early in life. Therefore, the second aim of this study was to investigate the link between AFDrink and problem behaviors according to whether or not the adolescents had already consumed so much alcohol that they felt drunk. Following the arguments above, early drinking should have an impact only among those who had been drunk but not among those who never experienced drunkenness. For example, in contexts (families or cultures) in which moderate drinking is highly valued or the norm, it should not matter at what age people take their first sip or glass of alcohol.

The third aim was to investigate whether, among those who experienced drunkenness, the age at first alcohol consumption (AFDrink) or the age at which drunkenness occurred for the first time (AFDrunk) was associated with problem behaviors at the age of 15. Ward and colleagues (2010) concluded in a recent literature review that the number of drunkenness episodes and the age at which they occur are more likely to predict later problems than the AFDrink per se. Dawson and colleagues (2008) concluded that "the most possible causal mechanisms linking early AFDrink and increased risk of alcohol use disorders entail the assumption that early drinking leads to heavy drinking during adolescence, with heavy exposure to ethanol (EtOH) during a period of physical and neurological maturation constituting the primary direct risk factor and/or marker of risk" (p. 2158). In other words, the "duration of heavy alcohol use, independent of AFDrink, is an important factor for certain alcohol-related consequences" (Rothman et al., 2008, p. 39). Thus, we expect that the earlier the AFDrunk the higher the level of problem behaviors.

However, whether an early AFDrink actually leads to an early AFDrunk and therefore indirectly to a higher level of problem behaviors is less clear. Because AFDrunk and AFDrink are logically dependent (i.e., there is no drunkenness without drinking), the usual mediation testing is not possible. Therefore, we investigated whether the time elapsed from AFDrink to AFDrunk predicts the level of problem behaviors over and above the age at which the first drunkenness occurred (AFDrunk). In other words, once the effect of the first drunkenness is taken into account does it still matter at what age the first sip of alcohol was consumed?

MATERIALS AND METHODS

Study Design

The data used for the analyses were part of the 2005/06 "Health Behaviour in School-Aged Children (HBSC)" study (Currie et al., 2008). In collaboration with the World Health Organization (WHO), HBSC surveys have been conducted every 4 years since 1983 among 11-, 13-, and 15-year-olds. Students were selected using a clustered sampling design, where either single classes or schools served as the sampling units.

Data were collected on the basis of anonymous self-report questionnaires distributed in the classroom. Each participating country obtained approval to conduct the survey from the relevant ethics review board or equivalent regulatory institution. In each country, every effort was taken to ensure that the international research protocol was followed to guarantee

consistency in survey instruments, data collection, and processing procedures. Further information can be found in Roberts and colleagues (2009) and online at www.hbsc.org.

Sample

The present analyses are based on 15-year-olds because AFDrink and AFDrunk were assessed in this age group only. The average response rate across the 38 countries was above 90% (Table 1). Because AFDrink and AFDrunk can only be investigated among drinkers, those who had never drunk any alcohol were excluded from the analyses. Participants who did not answer all the questions used in the analyses were excluded from the analyses (10.5% in total). The final sample consisted of 21,479 boys and 23,322 girls aged 15 who had consumed alcohol.

Measures

The questionnaire was developed by an interdisciplinary research group from the participating countries (detailed information in Currie et al., 2008). A centralized translation/back translation procedure was used to guarantee language equivalence.

Drunkenness Prevalence—The question was "Have you ever had so much alcohol that you were really drunk?" (once or more = 1, never = 0).

Subsequently, *AFDrink* and *AFDrunk* were assessed with the introductory question "At what age did you first do the following things?" The first item was "Drink alcohol (more than a small amount)," the second was "Get drunk." Response options included "never" and ranged from "11 years or younger" (=10.5; 11 minus half range to adjacent category; Wicki et al., 2006) to "15 years" (=15). Moreover, among those who were at least once drunk in their lives, a difference score was created by subtracting the AFDrink from the AFDrunk. This score measures how many years elapsed from drinking initiation to the first time drunk.

Five problem behavior variables were used as outcome measures:

Smoking was assessed with the question "How often do you smoke tobacco at present?" Answer categories ranging from "every day" (=30) to "I do not smoke" (=0) were coded to represent a 30- day frequency measure. To measure *cannabis use*, the question was "Have you ever taken cannabis in the last 12 months?" The answer categories ranged from never to 40 times or more. Mid-points of categories were used and 45 occasions for the upper category (40 times plus half range to mid-point of adjacent category; Wicki et al., 2006). Both variables were log-transformed to approximate a normal distribution and reduce the impact of extreme values (Tabachnick and Fidell, 2001).

For *Injuries/Fights* the questions were "In the last 12 months" (i) "how many times were you injured and had to be treated by a doctor or nurse?" and (ii) "how many times were you in a physical fight?" For both variables, the answer categories ranged from never (=0) to 4 times or more (=4.5).

For *Low Academic Performance* the question was "In your opinion, what does your class teacher(s) think about your school performance compared to your classmates?" Because of

the inverse coding of the answer categories (i.e., "very good" = 1, "good" = 2, "average" = 3, "below average" = 4), the variable measures low performance.

Analytic Strategy

Because of the clustering of individuals within countries, we estimated multilevel structural equation models using the Mplus 6.1 (Muthén and Muthén, 2010) software. Because of skewness and ordinal scaling of dependent variables, maximum likelihood robust estimation was used. The comparative fit index, the Tucker-Lewis index (both preferably 0.95 or higher), and the standardized root mean square residual and the root mean square error of approximation (both preferably 0.08 or lower) served as model fit indices (Chen et al., 2008; Iacobucci, 2010; Marsh et al., 2004). The ratio of the χ^2-value to the degrees of freedom (χ^2/df) is also given.

In a first model, the 5 dependent variables (tobacco use, cannabis use, injuries, fights, and low academic performance) were regressed on AFDrink. Second, this relationship was estimated separately among those who had experienced drunkenness at least once and those who never had been drunk. Third, among those ever drunk, we included the AFDrunk to predict the 5 problem behaviors. To do so, the time between the age of 15 and the AFDrink was divided into the time between age of 15 and AFDrunk and between AFDrunk and AFDrink.

Because of known differences in the magnitude of the 5 outcome variables across countries (Currie et al., 2008), random intercepts models were estimated. In a subsequent step, also the relationships with the independent variables described earlier were allowed to vary across the countries (random intercept random slope models). The resulting slope variance represents an indicator of the extent to which the reported overall relationships varied across the 38 countries and regions. Because of known gender differences in adolescent problem behavior (Currie et al., 2008), all models were estimated for boys and girls separately.

Because of the cluster sampling of schools or school classes instead of individuals, which can artificially enhance test power by factor 1.2 to 1.6 (Kuntsche, 2004; Roberts et al., 2004, 2009), and the extremely large sample size, the usual 5% a-error threshold was elevated to 1%. This was performed to avoid reporting as significant very small parameter estimates.

RESULTS

Lifetime prevalence of alcohol consumption across all countries (Table 1) was 79.8%, varying from 51.9% in the United States to 94.8% in Lithuania. As shown in Table 2, on average, twice as many boys and over 50% as many girls had been drunk than had not been drunk. Also, the average age of first drink among the 15-year-olds was 12.94, and the average age of their first drunkenness experience (if ever) was 13.18. Participants smoked an average of 5 (5.19) times in the last 30 days (Table 2). They reported using cannabis 2.55 times and were injured or involved in fights about once in the last 12 months. Those who reported drunkenness had a slightly lower AFDrink (t_{Boys} = 17.2, $p < 0.001$; t_{Girls} = 16.6, $p < 0.001$) than those without drunkenness experiences. The former had also a consistently higher level of problem behaviors than the latter.

The regression analyses indicate the lower the AFDrink the higher the level of problem behavior (Model 1 in Table 3). This was consistently the case for all 5 problem domains. However, when the relationship was estimated separately according to lifetime drunkenness prevalence (Model 2), a different picture emerged. Whereas the negative relationship was about the same or slightly higher among those who were drunk at least once, there was no or almost no association between those who had been never drunk (Table 3). The only exception, in which significant associations in the latter group were found, was cannabis use (only girls) and fights (both genders). However, also in these cases, the coefficients were 3 to 10 times lower than among those with drunkenness experiences. Additional analyses[1] revealed that the difference in association between the groups with and without drunkenness was also in these cases statistically significant at $p < 0.001$.

The subsequently estimated random intercept random slope models revealed that the cross-country variance of the AFDrink slopes was very small (i.e., $V_{Boys} < 0.001$; $V_{Girls} < 0.007$).[2] This means that the results shown Table 3 are consistent across the 38 countries and regions included.

As shown in Table 4, among those who had been drunk, the effect of the AFDrunk and the time that elapsed from the first drinking to the first drunkenness experience (time from AFDrink to AFDrunk) are shown. The first line (Model 2 in Table 4) among boys and girls shows the effect of the total time from AFDrink to age of 15 among those who with drunkenness experiences, consistent with the data shown in Table 3. Subsequently, the 5 problem behaviors were regressed on both the age at first drunkenness (AFDrunk) and the time from AFDrink to AFDrunk (Model 3). The results revealed that the earlier the AFDrunk the higher the level of all 5 problem behaviors. In contrast, significant associations for the time elapsed between AFDrink and AFDrunk and problem behaviors were found only for injuries (only girls) and fights (both genders). However, in this case, the coefficients were 3 to 5 times lower than those of the AFDrunk. Thus, also among those who had been drunk, AFDrink was of little significance for problem behaviors when AFDrunk was taken into account.

The subsequently estimated random intercept random slope models revealed that the cross-country variance of the AFDrunk slopes and of the slopes of the time elapsed between AFDrink and AFDrunk were very small (i.e., $V_{Boys} < 0.002$; $V_{Girls} < 0.008$).[3] This means that the results shown in Table 4 did not vary considerably across the 38 countries and regions.

DISCUSSION

The aim of the present study was to investigate the association between the AFDrink and the level of smoking, cannabis use, injuries, fights, and low academic performance at the age of

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[1]A separately estimated interaction model (results not shown but to be obtained from the authors upon request) demonstrated that the difference between those who had been never drunk and those who were drunk at least once in terms of AFDrink was significant ($p < 0.01$) for both boys and girls and for each of the dependent variables.

[2]Results not shown but available from the authors upon request.

[3]Results not shown but available from the authors upon request

15 when the AFDrunk was taken into account in a large sample of 15-year-olds in 38 different North American and European countries and regions.

In the first analyses (AFDrunk not taken into account), the reported negative association between AFDrink and all 5 problem behavior outcomes was consistent with the findings of the bulk of previous studies on the topic (Buchmann et al., 2009; van Diemen et al., 2008; Fergusson et al., 1994; Gruber et al., 1996; Hingson and Zha, 2009; Hingson et al., 2000, 2009; Komro et al., 2010; Peleg-Oren et al., 2009; Rothman et al., 2008; Swahn et al., 2008, 2010; Vieira et al., 2007). Further analysis, however, revealed that this link existed only among those who already "had consumed so much alcohol that they were really drunk" at least once by the age of 15. Unlike the consistent associations found for AFDrunk, among those without drunkenness experience, the age at which they had consumed their first alcohol was inconsistently related to the level of problem behaviors at the age of 15. Moreover, even among those who had been drunk at least once by the age of 15, AFDrunk was much more predictive than AFDrink. In this group, we found consistently across problem domains and for both boys and girls that the earlier someone experienced drunkenness, the higher was the level of problem behaviors at the age of 15. However, early onset of drinking (i.e., the time between alcohol initiation and first episode of drunkenness) showed no consistent or substantial associations with problem behaviors.

There are several possible explanations for these findings. First, heavy exposure to EtOH during a period of physical and neurological maturation can constitute a primary direct risk factor (Dawson et al., 2008) that alters developmental trajectories leading to problem behaviors (Buchmann et al., 2009; Pedersen and Skrondal, 1998). Early heavy drinking might also interfere with the development of adequate coping strategies, problem-solving skills (Buchmann et al., 2009; Swahn et al., 2008), and social relationships (Pedersen and Skrondal, 1998; Swahn et al., 2008). Second, early heavy drinking can be a marker, symptom, or component of a general problem syndrome rather than a specific and independent predictor of problem behaviors in later life (Dawson et al., 2008; McGue and Iacono, 2005; Prescott and Kendler, 1999). For example, early drunkenness could occur as a reaction to experienced negative life events (e.g., abuse or trauma), having alcohol-dependent parents, or showing severe conduct problems in childhood (Sartor et al., 2007; Zucker, 2008). Third, the small or nonexistent associations between AFDrink and problem behaviors after drunkenness were taken into account, suggesting that early onset of drinking without transition to drunkenness in early adolescence is of little or no importance for other problem behaviors. And even among those with drunkenness experiences, what has happened before the first drunkenness (i.e., the time elapsed since first drinking) was not consistently related to the level of problem behaviors at the age of 15. Early moderate drinking might often occur in the family context, which could provide normative influence on moderation, particularly within appropriate cultural contexts (e.g., Mediterranean countries; Ward et al., 2010). Alternatively, early age of first drink may for some youths simply reflect normal experimentation not associated with increased risk for problem drinking. More research is needed to identify characteristics of early initiators who go on to early and frequent drunkenness and those who do not. Nonetheless, our findings should not be interpreted as implying that early drinking should be promoted in any way. Notably, it was shown that parents who have strict attitudes against underage drinking contributed to

low levels of drunkenness and other problem behaviors of their adolescent children (Koutakis et al., 2008).

It should be emphasized that the findings were consistent across multiple countries. However, a limitation of the study is the retrospective assessment of AFDrink and the AFDrunk which is subject to recall bias (Parra et al., 2003). Fortunately, in the present study, the data collection occurred rather close to the indicated AFDrink and AFDrunk that attenuate possible measurement bias. This, however, implied that the period of 16 years and older was not covered and led to the exclusion of 1 of 5 participants who never consumed any alcohol up to that age. Because of the lowest category of "11 years and younger" to measure AFDrink (indicated by 19.2% among boys and 11.8% among girls) and AFDrunk (indicated by 5.2% among boys and 2.3% among girls), we do not know at what age exactly these participants initiated drinking and drunkenness. Moreover, childhood risk factors such as heavily drinking parents and conduct disorders that are likely to lead to both early drinking and early drunkenness could not be included in this study. This might also explain why even in the links between AFDrunk and later problem behaviors, the effect sizes were rather small and indicate that even after drunkenness initiation, many other factors may be responsible for the level of different problem behaviors. However, the fact that we found consistent results in the different models across all 5 problem behavior outcomes makes us believe that even in case of low effect sizes, the reported effects are substantial and robust. Finally, the outcome measures were simple frequency measures and fairly crude indicators of involvement in various health and social hazards. Additional information about these behaviors would probably have provided a more nuanced picture of the outcome measures. To overcome these limitations, future research should include childhood risk factors and use longitudinal designs following adolescents into young adulthood. Moreover, as the vast majority of the study participants were European and mostly from countries where onset of drinking occurs before or around early adolescence, it would be important to assess whether these findings are valid also in populations in which onset of drinking occurs at significantly older ages. The major strength of the study is the large multinational sample representing various parts of North America and Europe, and the standardization of its instrument and methods.

CONCLUSIONS

This study has important implications for both research and prevention. In contrast to previous studies (Buchmann et al., 2009; Komro et al., 2010; Swahn et al., 2008; Zucker, 2008), we did not see that an early AFDrink per se is a direct risk factor for later problem behaviors. Because there is no drunkenness without drinking, those who were already drunk had a somewhat lower AFDrink (cf., Table 2). However, even in this group, the AFDrink failed to be a strong and consistent predictor of problem behaviors at the age of 15 when the AFDrunk was taken into account, which is consistent with previous studies (Rothman et al., 2008; Sartor et al., 2007). Drunkenness rather than drinking per se is associated with various immediate detrimental consequences such as blackouts, hangovers, violence, and injuries (Gmel et al., 2003; Windle, 2003) and is particularly dangerous early in life when physical and neurological maturation still takes place (Dawson et al., 2008).

Also in contrast to previous arguments (Buchmann et al., 2009; DeWit et al., 2000; Eliasen et al., 2009; Gruber et al., 1996; Hingson and Zha, 2009; Hingson et al., 2000, 2009; Komro et al., 2010; Palmer et al., 2010; Pitkänen et al., 2005; Swahn et al., 2008), we cannot recommend that simply delaying the AFDrink is important to prevent problem behaviors. The presented results are rather in line with the conclusion of Prescott and Kendler (1999) formulated more than 1 decade ago: "measures designed to interrupt the path from early use to heavy drinking may be a more fruitful approach for decreasing risk for alcoholism [and other problems later in life] than attempts to delay initiation of alcohol use" (p. 106). Thus, consistent with the principles of harm reduction (Marlatt, 1998), interventions should focus mainly on adolescent drunkenness, with its obvious potential for harm, and less on the age at which people consume their first alcohol.

Acknowledgments

REFERENCES

Buchmann AF, Schmid B, Blomeyer D, Becker K, Treutlein J, Zimmermann US, Jennen-Steinmetz C, Schmidt MH, Esser G, Banaschewski T, Rietschel M, Schumann G, Laucht M. Impact of age at first drink on vulnerability to alcohol-related problems: testing the marker hypothesis in a prospective study of young adults. J Psychiatr Res. 2009; 43:1205–1212. [PubMed: 19332346]

Chen F, Curran PJ, Bollen KA, Kirby J, Paxton P. An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in Structural Equation Models. Sociol Methods Res. 2008; 36:462–494. [PubMed: 19756246]

Currie, C.; Nic Gabhainn, S.; Godeau, E.; Roberts, C.; Smith, R.; Currie, D.; Pickett, W.; Richter, M.; Morgan, A.; Barnekow, V., editors. HBSC international report from the 2005/06 survey. Copenhagen: World Health Organization Regional Office for Europe; 2008. Inequalities in young people's health.

Dawson DA, Goldstein RB, Chou SP, Ruan WJ, Grant BF. Age at first drink and the first incidence of adult-onsetDSM-IV alcohol use disorders. Alcohol Clin Exp Res. 2008; 32:2149–2160. [PubMed: 18828796]

DeWit DJ, Adlaf EM, Offord DR, Ogborne AC. Age at first alcohol use: a risk factor for the development of alcohol disorders. Am J Psychiatry. 2000; 157:745–750. [PubMed: 10784467]

van Diemen L, Bassani DG, Fuchs SC, Szobot CM, Pechansky F. Impulsivity, age of first alcohol use and substance use disorders among male adolescents: a population based case-control study. Addiction. 2008; 103:1198–1205. [PubMed: 18494839]

Eliasen M, Kjaer SK, Munk C, Nygård M, Sparén P, Tryggvadottir L, Liaw K-L, Grønbaek M. The relationship between age at drinking onset and subsequent binge drinking among women. Eur J Public Health. 2009; 19:378–382. [PubMed: 19321715]

Fergusson DM, Lynskey MT, Horwood LJ. Childhood exposure to alcohol and adolescent drinking patterns. Addiction. 1994; 89:1007–1016. [PubMed: 7950847]

Gmel G, Rehm J, Kuntsche E. Binge drinking in Europe: definitions, epidemiology, and consequences. Sucht. 2003; 49:105–116.

Grant BF, Dawson DA. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. J Subst Abuse. 1997; 9:103–110. [PubMed: 9494942]

Gruber E, DiClemente RJ, Anderson MM, Lodico M. Early drinking onset and its association with alcohol use and problem behavior in late adolescence. Prev Med. 1996; 25:293–300. [PubMed: 8781007]

Hawkins JD, Graham JW, Maguin E, Abbott R, Hill KG, Catalano RF. Exploring the effects of age of alcohol use initiation and psychosocial risk factors on subsequent alcohol misuse. J Stud Alcohol. 1997; 58:280–290. [PubMed: 9130220]

Hingson RW, Edwards EM, Heeren T, Rosenbloom D. Age of drinking onset and injuries, motor vehicle crashes, and physical fights after drinking and when not drinking. Alcohol Clin Exp Res. 2009; 33:783–790. [PubMed: 19298330]

Hingson RW, Heeren T, Jamanka A, Howland J. Age of drinking onset and unintentional injury involvement after drinking. JAMA. 2000; 284:1527–1533. [PubMed: 11000646]

Hingson RW, Heeren T, Winter MR. Age at drinking onset and alcohol dependence. Arch Pediatr Adolesc Med. 2006; 160:739–746. [PubMed: 16818840]

Hingson RW, Zha W. Age of drinking onset, alcohol use disorders, frequent heavy drinking, and unintentionally injuring oneself and others after drinking. Pediatrics. 2009; 123:1477–1484. [PubMed: 19482757]

Iacobucci D. Structural equations modeling: fit indices, sample size, and advanced topics. J Consum Psychol. 2010; 20:90–98.

Komro KA, Tobler AL, Maldonado-Molina MM, Perry CL. Effects of alcohol use initiation patterns on high-risk behaviors among urban, low-income, young adolescents. Prev Sci. 2010; 11:14–23. [PubMed: 19639410]

Koutakis N, Stattin H, Kerr M. Reducing youth alcohol drinking through a parent-targeted intervention: the Orebro Prevention Program. Addiction. 2008; 103:1629–1637. [PubMed: 18821873]

Kuntsche E. Progression of a general substance use pattern among adolescents in Switzerland? Investigating the relationship between alcohol, tobacco, and cannabis use over a 12-year period. Eur Addict Res. 2004; 10:118–125. [PubMed: 15258442]

Marlatt, GA., editor. Harm Reduction: Pragmatic Strategies for Managing High-Risk Behaviors. New York, NY: Guilford Press; 1998.

Marsh HW, Hau K-T, Wen Z. In search of golden rules: comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. Struct Equ Modeling. 2004; 11:320–341.

McGue M, Iacono WG. The association of early adolescent problem behavior with adult psychopathology. Am J Psychiatry. 2005; 162:1118–1124. [PubMed: 15930060]

McGue M, Iacono WG, Legrand LN, Malone S, Elkins I. Origins and consequences of age at first drink. I. Associations with substance-use disorders, disinhibitory behavior and psychopathology, and P3 amplitude. Alcohol Clin Exp Res. 2001; 25:1156–1165. [PubMed: 11505047]

Muthén BO, Muthén LK. The development of heavy drinking and alcohol-related problems from ages 18 to 37 in a U.S. national sample. J Stud Alcohol. 2000; 61:290–300. [PubMed: 10757140]

Muthén, LK.; Muthén, BO. Mplus: User's Guide. 6th ed.. Los Angeles, CA: Muthén & Muthén; 2010.

Palmer RS, Corbin WR, Cronce JM. Protective strategies: a mediator of risk associated with age of drinking onset. Addict Behav. 2010; 35:486–491. [PubMed: 20092955]

Parra GR, O'Neill SE, Sher KJ. Reliability of self-reported age of substance involvement onset. Psychol Addict Behav. 2003; 17:211–218. [PubMed: 14498815]

Pedersen W, Skrondal A. Alcohol consumption debut: predictors and consequences. J Stud Alcohol. 1998; 59:32–42. [PubMed: 9498313]

Peleg-Oren N, Saint-Jean G, Cardenas GA, Tammara H, Pierre C. Drinking alcohol before age 13 and negative outcomes in late adolescence. Alcohol Clin Exp Res. 2009; 33:1966–1972. [PubMed: 19719795]

Pitkänen T, Lyyra A-L, Pulkkinen L. Age of onset of drinking and the use of alcohol in adulthood: a follow-up study from age 8–42 for females and males. Addiction. 2005; 100:652–661. [PubMed: 15847623]

Prescott CA, Kendler KS. Age at first drink and risk for alcoholism: a noncausal association. Alcohol Clin Exp Res. 1999; 23:101–107. [PubMed: 10029209]

Roberts C, Freeman J, Samdal O, Schnohr C, Looze M, Nic Gabhainn S, Ianotti R, Rasmussen M. Group HMD. The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions. Int J Public Health. 2009; 54:140–150. [PubMed: 19639259]

Roberts, C.; Tynjälä, J.; Currie, D.; King, M. Annex 1.Methods, in Young People's Health in Context—Health Behaviour in School-Aged Children (HBSC) Study: International Report from the 2001/2002 Survey. Currie, C.; Roberts, C.; Morgan, A.; Smith, R.; Settertobulte, W.; Samdal, O.; Barnekow Rasmussen, V., editors. Copenhagen: World Health Organization Regional Office for Europe; 2004. p. 217-227.

Rothman EF, DeJong W, Palfai T, Saitz R. Relationship of age of first drink to alcohol-related consequences among college students with unhealthy alcohol use. Subst Abuse. 2008; 29:33–41.

Sartor CE, Lynskey MT, Heath AC, Jacob T, True W. The role of childhood risk factors in initiation of alcohol use and progression to alcohol dependence. Addiction. 2007; 102:216–225. [PubMed: 17222275]

Swahn MH, Bossarte RM, Ashby JS, Meyers J. Pre-teen alcohol use initiation and suicide attempts among middle and high school students: findings from the 2006 Georgia Student Health Survey. Addict Behav. 2010; 35:452–458. [PubMed: 20089362]

Swahn MH, Bossarte RM, Sullivent EE 3rd. Age of alcohol use initiation, suicidal behavior, and peer and dating violence victimization and perpetration among high-risk, seventh-grade adolescents. Pediatrics. 2008; 121:297–305. [PubMed: 18245421]

Tabachnick, BG.; Fidell, LS. Using Multivariate Statistics. 4th ed.. Boston, MA: Allyn and Bacon; 2001.

Vieira DL, Ribeiro M, Laranjeira R. Evidence of association between early alcohol use and risk of later problems. Rev Bras Psiquiatr. 2007; 29:222–227. [PubMed: 17891259]

Ward B, Snow P, Aroni R. Children's alcohol initiation: an analytic overview. Drugs Educ Prev Pol. 2010; 17:270–277.

Warner LA, White HR. Longitudinal effects of age at onset and first drinking situations on problem drinking. Subst Use Misuse. 2003; 38:1983–2016. [PubMed: 14677779]

Wicki M, Gmel G, Kuntsche E, Rehm J, Grichting E. Is alcopop consumption in Switzerland associated with riskier drinking patterns and more alcohol-related problems? Addiction. 2006; 101:522–533. [PubMed: 16548932]

Windle M. Alcohol use among adolescents and young adults. Alcohol Res Health. 2003; 27:79–86. [PubMed: 15301402]

Zucker RA. Anticipating problem alcohol use developmentally from childhood into middle adulthood: what have we learned? Addiction. 2008; 103:100–108. [PubMed: 18426543]

Table 1

Response Rates, Percentage of ThoseWho Had Consumed Alcohol and Final Sample Size in Each Country

	Response rate[a]	Prevalence of alcohol use	Final sample size[b]	Prevalence of drunkenness[b]
Austria	87.7	87.1	1,215	65.7
Belgium (Flemish)	97.3	88.1	1,346	54.2
Belgium (French)	_c	80.6	998	52.1
Bulgaria	100	83.1	1,318	77.6
Canada	92.3	71.7	1,526	73.9
Croatia	100	85.2	1,307	66.3
Czech Republic	100	89.9	1,390	57.8
Denmark	94.4	88.7	1,184	79.7
England	_c	84.6	1,072	76.0
Estonia	100	87.7	1,316	76.0
Finland	89.4	70.0	1,006	81.7
France	79.1	69.4	1,470	56.3
Germany	46.7	85.2	1,986	53.3
Greece	96.3	86.7	1,112	43.3
Greenland	_c	78.2	221	80.5
Hungary	98.1	87.1	921	58.5
Iceland	99.2	56.7	1,024	77.5
Ireland	98.9	72.0	1,043	66.8
Italy	95.5	74.1	902	45.7
Latvia	98.1	84.0	540	80.4
Lithuania	100	94.8	1,643	81.6
Luxemburg	74.3	83.7	1,157	48.0
FYRO Macedonia	100	61.9	1,140	50.1
Malta	_c	71.5	229	55.9
The Netherlands	99.1	85.9	1,128	49.6
Poland	100	88.9	1,980	56.4
Portugal	86.4	79.8	1,006	42.7
Romania	100	77.3	1,144	60.4
Russia	82.2	78.7	1,830	70.3
Scotland	75.8	85.9	1,705	73.7
Slovakia	_c	87.1	970	56.8
Slovenia	98.2	83.0	1,215	69.1
Spain	94.0	74.3	2,123	54.1
Sweden	90.2	63.9	765	62.1
Switzerland	85.7	82.1	1,079	47.6
Ukraine	_c	85.1	1,362	72.5
United States	99.1	51.9	293	71.7

	Response rate[a]	Prevalence of alcohol use	Final sample size[b]	Prevalence of drunkenness[b]
Wales	56.8	90.7	1,135	83.3
Total	91.1	79.8	44,801	63.6

[a] At class level in percent.

[b] Of those who consumed alcohol at least once.

[c] Not available.

Table 2

Means and Standard Deviations in Brackets of the Variables Used in this Study According to Gender and Drunkenness Status

	Total	Never been drunk	Drunk at least once
Boys (*N*)	21,479	7,301	14,178
Age at initiation			
AFDrink(in years)	12.94(1.5)	13.18(1.5)	12.81(1.5)
AFDrunk(in years)	–	–	13.83(1.2)
Problem behaviors			
Smoking occasions[a]	5.19(10.9)	1.11 (5.3)	7.29(12.4)
Cannabis use[b]	2.55(8.7)	0.35(3.1)	3.69(10.3)
Injuries[b]	0.94(1.2)	0.73(1.1)	1.04(1.3)
Fights[b]	1.15(1.5)	0.73(1.2)	1.36(1.6)
Low academic performance[c]	2.47(0.8)	2.33(0.8)	2.54(0.8)
Girls (*N*)	23,322	9,026	14,296
Age at initiation			
AFDrink(in years)	13.24(1.4)	13.43(1.4)	13.12(1.3)
AFDrunk (in years)	–	–	14.03(1.0)
Problem behaviors			
Smoking occasions[a]	5.36(11.0)	1.23 (5.5)	7.98(12.7)
Cannabis use[b]	1.46(6.2)	0.16(1.7)	2.28(7.7)
Injuries[b]	0.67(1.1)	0.52(1.0)	0.76(1.1)
Fights[b]	0.48(1.0)	0.27(0.8)	0.62(1.2)
Low academic performance[c]	2.34(0.8)	2.18(0.8)	2.44(0.8)

[a] In the last 30 days.

[b] In the last 12 months.

[c] Answer categories were "very good" coded as 1, "good" coded as 2, "average" coded as 3, and "below average" coded as 4.

Table 3

Problem Behavior Regressed on Age at First Drink Separately by Gender and Drunkenness Status

	Smoking	Cannabis use	Injuries	Fights	Low academic performance
Boys					
Model 1: AFDrink among boys in general	−0.10***	−0.17***	−0.06***	−0.13***	−0.03***
Model 2: AFDrink among those never drunk	0.01	−0.03	−0.02	−0.06***	0.02
Model 2: AFDrink among those drunk at least once	−0.09***	−0.16**	−0.06***	−0.13***	−0.04***
Girls					
Model 1: AFDrink among girls in general	−0.14***	−0.16***	−0.07***	−0.12***	−0.04***
Model 2: AFDrink among those never drunk	−0.02	−0.05***	−0.02	−0.05***	0.01
Model 2: AFDrink among those drunk at least once	−0.13***	−0.17***	−0.07***	−0.13***	−0.04***

Model fit: comparative fit index > 0.98, Tucker-Lewis index > 0.97, χ^2/df < 144, root mean square error of approximation < 0.02, standardized root mean square residual < 0.01 for all models;

**
$p < 0.001$;

***
$p < 0.001$; shown are standardized regression coefficients.

Table 4

Problem Behavior Regressed on Age at First Drunkenness (AFDrunk) and the Time in Years From the Age at First Drink and the Age of First Drunkenness (cf., Table 3) Among Those Having Experienced Drunkenness at Least Once

	Smoking	Cannabis use	Injuries	Fights	Low academic performance
Boys					
Model 2: AFDrink among those drunk at least once	−0.09***	−0.16**	−0.06***	−0.13***	−0.04***
Model 3: AFDrunk	−0.17***	−0.23***	−0.08***	−0.16***	−0.06***
Model 3: Time from AFDrink to AFDrunk	0.03	−0.01	−0.01	0.04***	0.00
Girls					
Model 2: AFDrink among those drunk at least once	−0.13***	−0.17***	−0.07***	−0.13***	−0.04***
Model 3: AFDrunk	−0.21***	−0.26***	−0.08***	−0.17***	−0.06***
Model 3: Time from AFDrink to AFDrunk	0.01	0.02	0.03***	0.04***	0.00

Model fit: comparative fit index > 0.98, Tucker-Lewis index > 0.97, χ^2/df < 144, root mean square error of approximation < 0.02, standardized root mean square residual < 0.01 for all models;

**
$p < 0.01$;

***
$p < 0.001$; shown are standardized regression coefficients.