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Types of Alcohol Use Experience from Childhood through Adolescence

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Abstract

Purpose—There have been few reports of the development of alcohol involvement from childhood through adolescence. We examined the ages at which children first sipped or tasted alcohol, drank, had 3+ drinks in a row, had 5+ drinks in a row, were drunk, or had alcohol problems in order to describe the types of drinking experience exhibited at each age from 8.5 through 18.0. Sipping and 3+ drinks/occasion have been understudied to date.

Methods—Fourteen waves of longitudinal data were collected from 452 children aged 8 or 10 randomly sampled from Allegheny County (PA). Ages of initiating each alcohol use behavior were determined, and the data were coded to reflect the child's status on each behavior at each age. Types of alcohol use experience were determined using Latent Class Analyses..

Results—From age 8.5 to 12.5, there were two latent classes: Abstainers and Sippers. The percentage of Sippers increased to 67% by age 12.5. From age 13.0 to 18.0, three latent classes were identified: Abstainers, Sippers/Light Drinkers, and Drinkers with Drunkenness. At ages 13.5 to 15.5, drinkers in the latter class reported drunkenness with just 3–4 drinks per occasion. By age 18, Sippers/Light Drinkers comprised 55% of the sample and Drinkers with Drunkenness comprised 38%.

Conclusions—Childhood experience with alcohol was surprisingly widespread. Sipping or tasting alcohol was common by age 12. A quarter of the sample drank before age 15. Experience of intoxication increased throughout adolescence, even among those who had ever consumed just 3–4 drinks on an occasion.

Keywords

Alcohol Sipping; Alcohol Use; Children; Adolescents; Latent Class Analyses

Epidemiologic data show that alcohol involvement increases with age as children move into and through adolescence. Nationwide age trends among U.S. adolescents are reported by the Monitoring the Future (MTF) project [1], the Youth Risk Behavior Survey (YRBS)[2], and the National Survey on Drug Use and Health (NSDUH)[3]. The federal government does

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not, however, collect ongoing surveillance data on alcohol use among children. The most recent data on U.S. children come from the cross-national Health Behaviour of School-aged Children (HBSC) study and show that weekly alcohol consumption rates increased from age 11 to age 15 for both sexes [4]. Previously unpublished U.S. national and statewide surveys show that alcohol use increases in prevalence between fourth and sixth grades, and that rates have been decreasing over time [5].

Relatively few studies, however, have described the normative development of alcohol involvement using longitudinal samples followed from childhood into and through adolescence. For example, the Dunedin Multidisciplinary Health and Development Study reported rates of abstention, sipping, and drinking at ages 9, 11, 13, and 15 [6]. The Avon Longitudinal Study of Parents and Children reported rates of ever use at age 10 and of drinking and binge drinking at ages 13 and 15 [7]. In the Seattle Social Development Project, rates of ever drinking were reported for ages 10½ to 18 [8]. Rates of having ever tried alcohol were reported for grades 1 to 7 in a study of 5 grade-cohorts in Oregon [9]. A second study in Oregon described the latent growth of frequency of drinking from ages 9 to 16 [10].

These previous longitudinal studies are lacking in three important respects: 1) they skipped ages within childhood and particularly in middle adolescence; 2) they assessed only a few alcohol use behaviors; and 3) they treated each behavior independently. In the interest of providing a more useful descriptive epidemiology of alcohol involvement across these life stages, the present paper focused on the distribution of types or classes of alcohol use behavior experienced by each age from age 8 to age 18.

With its focus on the profile of alcohol use behaviors experienced by each age, this paper expands the literature on alcohol initiation, which has focused predominantly on age at first drink [e.g., 11–17], with relatively few studies of ages of first drunkenness [18, 19] or initiation of alcohol abuse [20, 21]. Importantly, this literature has overlooked the alcohol use behaviors most relevant to child and early adolescent drinking, namely, sipping/tasting alcohol [6, 22] and intake of three or more drinks per occasion, a developmentally-appropriate indicator of binge drinking in this younger, physically smaller population of children [23]. Furthermore, no studies have tried to integrate these initiation ages to permit comprehensive description of the developmental course of progression in alcohol involvement from childhood into and through adolescence.

In the present research, normative progression in involvement with alcohol was assessed using children's self-reports of their initiation of sipping, drinking, binge drinking, drunkenness, and drinking problems. Latent Class Analyses (LCA) were used to identify how many different clusters or patterns of alcohol use experience there were at each age [24]. Unlike previous LCA studies which focused on patterns of current alcohol use [25–27], the focus here is on the patterns of alcohol use behaviors children had ever engaged in by each age. The resulting classes or types summarize the cumulative alcohol experience of the children by each age, and changes in the number and characteristics of the classes as the sample ages capture the expansion of their drinking repertoires as they move into and through adolescence.

Methods

Data were collected in the first 14 waves of the Tween to Teen Project, an ongoing longitudinal study of child and adolescent risk factors for drinking [13, 22]. Families in Allegheny County, PA were selected using targeted-age directory sampling and random digit dialing to fill age, gender, racial, and mother marital status quotas: 63% of eligible

families agreed to participate and 56% (n=452) completed baseline interviews [22]. Participants did not differ significantly from the other 703 families (Unable to Contacts, Ineligibles, Refusals, Non-completers) on the screening variables of race, child's age cohort, or mother's education [22]. Research procedures were approved by the Institutional Review Board of the University of Pittsburgh. A Certificate of Confidentiality was obtained from the National Institute on Alcohol Abuse and Alcoholism.

The baseline sample was composed of two age cohorts. Of the 452 families, 210 families had an 8-year-old child (118 girls, 92 boys), 242 had a 10-year-old child (120 girls, 122 boys). African American families were oversampled (24% vs. 13% locally and nationally); European American families were 73% (vs. 83% locally, 80% nationally); and two percent were Other (vs. 2.5% Asian and 1.5% Hispanic locally). One-quarter (23%) were single-mother households. Four percent of mothers completed some high school, 15% graduated high school, 14% had vocational training, 24% attended college, 32% graduated college, and 11% had post-graduate education. Nationally, 24% of people aged 25+ had a bachelor's degree.

Computer-assisted interviews were completed at home or in our offices. Child interviews were performed every 6 months (with 1.5 years between Waves 7 and 8). In this cohort-sequential design, younger cohort members participated at average ages 8.5 through 16.0 and older cohort members participated at average ages 10.5 through 18.0. This design permits description of a broader age range within a shorter span of years. At Wave 14 (7.5 years after baseline), 82% (n=371) participated. There were no gender or cohort differences in retention, but African-American families were significantly less likely to continue (24% Wave 1 vs. 21% Wave 14). To assess attrition bias, we examined a set of 13 Wave-1 personality, social environment, and behavior measures used previously [22] to summarize psychosocial proneness for deviance in Problem Behavior Theory [28]. Discontinuers differed from Continuers on just one measure (Religious Behavior), and together the 13 variables accounted for only 1.2% of the variance in attrition.

Measures of Alcohol Use Behavior

At each wave, children were asked if they had ever had a sip or a taste of alcohol (beer, wine, or liquor), ever had a drink (not just a sip of someone else's drink), ever had 3 or more drinks on a single occasion, ever had 5 or more drinks on a single occasion, ever been drunk (or very, very high) on alcohol, and ever experienced two or more alcohol problems (hangovers, blackouts, vomiting or passing out) or negative consequences because of their drinking (including trouble with parents, friends, at school, and trouble with the police). Many of these questions were first developed by Jessor and Jessor [28] and have been used extensively since [29].

For each alcohol use behavior, we determined the data wave at which a child first reported the behavior. If the child reported the same behavior at the next wave as well (confirming their previous report), we used the age at interview for the initial report as a conservative measure of their age of initiation for that behavior. For the present analyses, children were coded at each age from 8.0 to 18.5 as either not having yet initiated (0) or as having initiated (1) each alcohol use behavior. With respect to alcohol problems, children had to report negative consequences in two or more areas within a 6-month period to qualify. Members of the younger age cohort (who participated at average ages 8.5–16.0) were assigned missing values at ages older than their Wave-14 age; members of the older cohort (who participated at average ages 10.5–18.0) were assigned missing values at ages younger than their baseline age.

Analytic Procedures

Latent Class Analysis can be considered a form of cluster analysis that is based on categorical indicators (observed measures) and that takes account of measurement error. Analyses were performed using Latent GOLD 4.0 [30] to determine the number of different patterns (or latent classes) of alcohol use behavior the children had initiated by each age. Separate LCA were carried out for each half-year age group (reflecting the semi-annual data collections) from age 8.5 through 18.0. (Groups aged 8.0 and 18.5 were considered too small.) The average group size was 326.3 (range = 164 – 422). Due to the cohort sequential design of the study, no children had data at all ages.

LCAs were performed to determine how many classes were needed at each age to best describe the diversity of alcohol experience. At each age, we examined four LCA models to test whether one, two, three, or four latent classes best fit the data. The best fitting model at each age is generally the one that achieves the lowest Bayesian Information Criterion (BIC), the lowest-order model (smallest number of classes) with a non-significant Likelihood Ratio Chi-square (L^2) (following the principle of parsimony), and which produces latent classes with the highest level of homogeneity (similarity of members) within classes and the greatest separation (diversity) among classes [24]. The characteristics of each latent class are described by the pattern of conditional probabilities of a positive response on each alcohol use behavior given membership in the latent class. These response probabilities should differ widely among the latent classes.

Results

Mean Ages at Initiation of Alcohol Use Behaviors

Table 1 presents the overall mean ages for initiating each alcohol use behavior, as well as mean differences between ages of initiation (for those who initiated both behaviors). Based on paired-sample *t*-tests, sipping or tasting was initiated significantly younger (3.58 years) than first drink. First having 3+ drinks on an occasion (child binge), first drunkenness, first 5+drinks per occasion (heavy intake), and first experience of 2+ alcohol problems occurred on average about 1.4–1.7 years after first drink. First child binge (3+ drinks) occurred on average about one-half year before first heavy intake (5+ drinks) and first experience of 2+ alcohol problems; and first heavy intake preceded experience of 2+ alcohol problems by about one-quarter year on average. Interestingly, first drunkenness occurred at a younger age than first heavy intake (5+ drinks) but at the same age as first child binge (3+ drinks).

Prevalence of Alcohol Use Behaviors at Each Age

Table 2 reports the percentage of children at each age from 8 to 18.5 who had initiated each alcohol use behavior or who were still abstainers. Abstention from alcohol decreased from 63% of 8 year olds to just 2% of 18 year olds. In contrast, sipping or tasting alcohol was common even at age 8 (37%) and became nearly universal by age 18 (96%). Having a drink was rare in middle childhood (5% at age 11.5), but was fivefold greater by the end of early adolescence (25% by age 14.5), and was normative by the end of middle adolescence (63% at age 17.5). No children and few early adolescents had as many as three drinks on a single drinking occasion. The same was true for drunkenness, having 5+ drinks on an occasion, and having experienced 2+ negative consequences of drinking within a 6-month period. These alcohol behaviors all became more common as the children moved into and through adolescence.

Establishing the Number of Latent Classes in Each Age Group

The goal of the LCA was to determine how many classes were required to best capture the diversity of alcohol use experience at each age from 8.5 to 18.0 (see Table 3 for results). The characteristics of the best-fitting classes are described in the next section.

For ages 8.5 to 12.5, the BIC for a 2-class solution was significantly smaller than for a 1-class solution. Due to the absence of other alcohol behaviors at ages 8.5–10.5 (see Table 2), the L^2s had negative degrees of freedom and could not be tested for statistical significance.

For ages 11.0 to 12.5, however, the L^2s had a probability of 1.00 (df=112). The 2-class model fit best for these ages. For ages 13.0 through 18.0, the 3-class solution fit best. It fit better than the 2-class solution, exhibiting a significantly lower BIC and lower L^2, and all of the L^2s for the 3-class solution but one (for age 16.0) had probabilities of 1.00 (df=104). The 3-class solution also fit better than the 4-class solution at all ages, even at ages 16.0 and 16.5 where it had slightly larger BICs (due to its better separation among the classes than the 4-class solution at age 16.0, and due to its greater homogeneity within the classes than the 4-class solution at age 16.5).

Description and Distribution of the Latent Classes

Table 4 describes the latent classes comprising the best-fitting LCA solution at each age. Each latent class can be characterized by its pattern of conditional probabilities across the alcohol use behaviors. A conditional probability close to 1.0 indicates that members of the class had a high probability of having engaged in that alcohol use behavior. A conditional probability close to 0 indicates that members of the class had a high likelihood of not having yet engaged in the alcohol use behavior. Both reflect a high degree of homogeneity within the latent class.

Two latent classes were found for ages 8.5 through 12.5. Based on the conditional probabilities in Table 4, these classes can be called Abstainers and Sippers. Members of the Abstainer latent class reported no experience of any of the alcohol use behaviors. The percentage in this class (see Table 4) ranged from 62% at age 8.5 to 40% at age 11.5 (the end of middle childhood), 23% at age 14.5 (the end of early adolescence), and 9% at age 17.5 (the end of middle adolescence).

Up through age 12.5, the second, Sipper class consisted of those who reported only having a sip of alcohol and no other alcohol use behaviors. From age 13.0 onward, class members were increasingly likely to also have had a drink of alcohol (see conditional probabilities in Table 4), hence the label for the class of Sippers/Light Drinkers. They also had a zero or very low probability of having ever had 3+ drinks on an occasion, ever being drunk, or ever having had 2+ alcohol problems. The prevalence of this class was 39% at age 8.5, 60% at age 11.5 (the end of middle childhood), 71% at age 14.5 (the end of early adolescence), and decreased to 62% at age 17.5 as more of the sample were assigned to the third latent class.

On the basis of their conditional probabilities on the alcohol behavior measures, the third latent class can be called Drinkers with Drunkenness. The character of this class also changes with age. From ages 13.5 to 15.5, this class was characterized by a high probability of having had 3–4 drinks on an occasion and having been drunk, but a low probability of having ever engaged in an adult-sized binge of 5+ drinks. From ages 16.0 to 18.0, the probability was higher of having also had 5+ drinks on an occasion and having had 2+ alcohol problems within a six-month period. The prevalence of this latent class was low prior to middle adolescence (6% at age 14.5), doubled by age 16.0 (14%), and doubled again by age 17.5 (29%).

Examination of the sequence of class memberships for individual children/adolescents, based on their probabilistic assignment to classes, showed that just three of the Abstainers moved directly into the Drinkers with Drunkenness class. Everyone else transitioned into the latter class from the Sipper/Light Drinker class.

Sex and Racial Group Differences in Latent Class Membership

LCA analyses were also run including the covariates of sex and race to test for group differences in alcohol experience at each age. Sex differences were non-significant ($p > .05$) in all 20 age groups. In comparison with European Americans, more African American children were Abstainers and fewer were Sippers/Light Drinkers through age 13 (see Wald tests in Table 5). Although race was generally not significant at ages 13.5 and older, fewer African American adolescents tended to be Drinkers with Drunkenness at most ages.

Discussion

The rationale for the present latent class analyses was that simple reports of the mean ages of onset fail to capture the full picture of child or adolescent experience with alcohol by any given age. Using prospectively derived ages of onset to generate age-specific statuses on the various alcohol use behaviors permitted us to describe the patterns of experience with alcohol exhibited by children at different ages. These classes thus portray the developmental course of alcohol involvement from childhood through adolescence.

A major contribution of the present research was in its illustration of the course of development of sipping or tasting alcohol, a behavior largely ignored by most previous research (but see [6, 22, 31]). By age 11, fully half of the children had this level of experience with alcohol. By age 18.5, nearly all (96%) had sipped or tasted alcohol. The rates of childhood sipping may be concerning because our earlier research [13] suggests that sipping relates to early-onset drinking which relates to other problematic behaviors in adolescence and young adulthood [12,15,16,32–36].

The LCA results suggest that the most common pattern of experience with alcohol through adolescence involved either having sipped/tasted alcohol or having had a drink or two at most on any single occasion with no experience of alcohol problems. Drinking to drunkenness was rarely seen before middle adolescence.

The LCA results illustrate the covariation among the various alcohol use behaviors in ways that other analyses cannot. For example, between ages 13.5 and 15.5 first intoxication and first having 3–4 drinks/occasion were both highly likely to occur but first adult-sized binge of 5+ drinks was unlikely to occur until later, suggesting that drunkenness can result from less alcohol at these ages. This result is fully consistent with recent estimates [23] that children aged 9–13 and girls aged 14–17 can reach blood alcohol concentrations of .08 g/dL or higher (legal intoxication) with just 3 standard drinks within a 2-hour period. These analyses thus buttress the argument that child and adolescent intake of 3+ drinks per occasion should be routinely monitored.

The LCA results further suggest that there is additional expansion in alcohol use experience through middle adolescence. This was shown by the increasing likelihood that drinkers would also have experienced intoxication, heavy intake (5+ drinks), and alcohol problems and negative consequences at ages 16 through 18.

Age differences in the prevalence of these latent classes of alcohol use experience may be used to identify ages at which prevention efforts might be focused. Between ages 11.0 and 12.0, there was a 13% increase (from 52% to 65%) in membership in the Sipper/Light

Drinker class (as well as a doubling in the likelihood that sippers in the class would also have initiated drinking). This suggests that prevention efforts might best be targeted for grade 5 to curtail this transition (see also [5]). Similarly, there is a doubling in the prevalence of the Drinker/Drunkenness class from age 16 to age 17.5 (from 14% to 28%), suggesting that prevention efforts prior to age 16 might usefully focus on deterring the transition from sipping or light drinking into binge drinking, drunkenness, and alcohol problems.

An important limitation of the present research is that it was based on children from a single county with few Hispanic or Asian families and therefore may not generalize to the larger U.S. population. Although the lifetime drinking rates in our sample are comparable to those found in the nationwide NSDUH survey [3], our rates of ever binge drinking are lower (see Table 2 footnote), implying that estimates of the prevalence of the classes found may be conservative. Moreover, the modest size of the sample and sparseness within the contingency table may have limited both our ability to identify additional classes of alcohol involvement at the older ages and to examine latent class transitions across all of the ages studied. Subsequent research may be able to determine transition probabilities between classes for selected ages. These limitations argue for the need to replicate these analyses in larger, more representative samples. Lastly, drinking was assessed only by self reports. Such data, however, are generally reliable and valid in children [37] and adolescents [38], and initiation ages in this study were conservatively established using a minimum of two consecutive prospective reports.

Nevertheless, results such as these provide a fuller description of the normative patterns of alcohol involvement from childhood through adolescence. The present data establish that even young children have had some experience with alcohol. Clinicians might consider dissuading parents from letting their children sip given its relation in our sample to early initiation of drinking [13]. The same is true for drinking and for having 3+ drinks on a single occasion. According to the recently published NIAAA Screening Guide [39], any drinking by children places them at risk for involvement in other problem behaviors. Among adolescents, it is their age and their frequency of drinking which together determine their risk of alcohol problems and whether they should receive a brief motivational interview and possible referral for further evaluation [39, 40]. Further longitudinal research is required to determine just how much drinking and what pattern of alcohol experience engenders the most risk for later problematic outcomes.

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References

1. Johnston, LD.; O'Malley, PM.; Bachman, JG., et al. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2012. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2013. Available at: http://www.monitoringthefuture.org [Accessed January 28, 2013.]
2. Eaton DK, Kann L, Kinchen S, et al. Youth risk behavior surveillance—United States, 2011. MMWR Surveill Summ. 2012; 61(4):1–162. [PubMed: 22673000]
3. Substance Abuse and Mental Health Administration. Results from the 2011 National Survey on Drug Use and Health: Mental health findings (NSDUH Series H-45, HHS Publication No (SMA) 12-4725). Rockville, MD: Substance Abuse and Mental Health Administration; 2012.

4. Currie, C.; Zanotti, C.; Morgan, A., et al. Social determinants of health and well-being among young people: Health Behaviour in School-aged Children (HBSC) Study: International Report from the 2009/2010 Survey. Copenhagen: WHO Regional Office for Europe; 2012. Available at: http://www.hbsc.org/publications/international/ [Accessed August 1, 2012.]
5. Donovan JE. Really underage drinkers: The epidemiology of children's alcohol use in the United States. Prev Sci. 2007; 8:192–205. [PubMed: 17629790]
6. Casswell S, Stewart J, Connolly G, et al. A longitudinal study of New Zealand children's experience with alcohol. Brit J Addict. 1991; 86:277–85. [PubMed: 2025690]
7. MacArthur GJ, Smith MC, Melotti R, et al. Patterns of alcohol use and multiple risk behavior by gender during early and late adolescence: The ALSPAC cohort. J Pub Health. 2012; 34(S1):20–30.
8. Kosterman R, Hawkins JD, Guo J, et al. The dynamics of alcohol and marijuana initiation: Patterns and predictors of first use in adolescence. Am J Pub Health. 2000; 90:360–66. [PubMed: 10705852]
9. Andrews JA, Tildesley E, Hops H, et al. Elementary school age children's future intentions and use of substances. J Clin Child Adolesc Psychol. 2003; 32:556–67. [PubMed: 14710464]
10. Duncan SC, Duncan TE, Strycker LA. Alcohol use from ages 9 to 16: A cohort-sequential latent growth model. Drug Alc Depend. 2006; 81:71–81.
11. Chen, CM.; Yi, H.; Faden, VB. Surveillance Report #91: Trends in underage drinking in the United States, 1991–2009. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism; 2011.
12. DeWit DJ, Adlaf EM, Offord DR, et al. Age of first alcohol use: A risk factor for the development of alcohol disorders. Am J Psychiatr. 2000; 157:745–50. [PubMed: 10784467]
13. Donovan JE, Molina BSG. Childhood risk factors for early-onset drinking. J Stud Alcohol Drugs. 2011; 72:741–51. [PubMed: 21906502]
14. Faden VB. Trends in initiation of alcohol use in the United States 1975 to 2003. Alcoholism Exp Clin Res. 2006; 30:1011–22.
15. 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; 9:103–10. [PubMed: 9494942]
16. Hingson RW, Heeren T, Winter MR. Age at drinking onset and alcohol dependence: Age at onset, duration, severity. Arch Pediatrics Adolesc Med. 2006; 160:739–746.
17. Kuperman S, Chan G, Kramer JR, et al. A model to determine the likely age of an adolescent's first drink of alcohol. Pediatrics. 2013; 131:242–8. [PubMed: 23296431]
18. Afitska N, Plant MA, Weir I, et al. The relationship between teenage "binge" drinking, age of first alcohol consumption and intoxication. J Subst Use. 2008; 13:205–218.
19. Hellandsjø Bu ET, Watten RG, Foxcroft DR, et al. Teenage alcohol and intoxication debut: The impact of family socialization factors, living area and participation in organized sports. Alcohol Alcohol. 2002; 37:74–80. [PubMed: 11825861]
20. Jackson KM. Progression through early drinking milestones in an adolescent treatment sample. Addiction. 2010; 105:438–49. [PubMed: 20402987]
21. Sartor CE, Lynskey MT, Bucholz KK, et al. Timing of first alcohol use and alcohol dependence: Evidence of common genetic influences. Addiction. 2009; 104:1512–18. [PubMed: 19686520]
22. Donovan JE, Molina BSG. Children's introduction to alcohol use: Sips and tastes. Alcoholism Clin Exp Res. 2008; 32:108–19.
23. Donovan JE. Estimated blood alcohol concentrations for child and adolescent drinking and their implications for screening instruments. Pediatrics. 2009; 123:e975–81. [PubMed: 19482748]
24. Collins, LM.; Lanza, ST. Latent class and latent transition analysis with applications in the social, behavioral and health sciences. Hoboken, NJ: Wiley; 2010.
25. Dauber SE, Hogue A, Paulson JF, et al. Typologies of alcohol use in white and African American adolescent girls. Subst Use Misuse. 2009; 44:1121–41. [PubMed: 19544150]
26. Lanza ST, Collins LM, Lemmon DR, et al. PROC LCA: A SAS procedure for latent class analysis. Struct Equation Model. 2007; 14:671–94.

27. Reboussin BA, Song E-Y, Shrestha A, et al. A latent class analysis of underage problem drinking: Evidence from a community sample of 16–20 year olds. Drug Alcohol Depend. 2006; 83:199–209. [PubMed: 16359829]
28. Jessor, R.; Jessor, SL. Problem behavior and psychosocial development: A longitudinal study of youth. New York: Academic Press; 1977.
29. Donovan JE, Jessor R, Costa FM. Adolescent problem drinking: Stability of psychosocial and behavioral correlates across a generation. J Stud Alcohol. 1999; 60:352–61. [PubMed: 10371263]
30. Vermunt, JK.; Magidson, J. Latent GOLD 4.0 user's manual. Belmont, MA: Statistical Innovations, Inc; 2005.
31. Jackson C, Ennett ST, Dickinson DM, et al. Letting children sip: Understanding why parents allow alcohol use by elementary school-aged children. Arch Pediatr Adolesc Med. 2012; 166:1053–7. [PubMed: 22986887]
32. Ellickson PL, Tucker JS, Klein DJ, et al. Prospective risk factors for alcohol misuse in late adolescence. J Stud Alcohol. 2001; 62:773–82. [PubMed: 11838914]
33. Ellickson PL, Tucker JS, Klein DJ. Ten-year prospective study of public health problems associated with early drinking. Pediatrics. 2003; 111:949–55. [PubMed: 12728070]
34. Gruber E, DiClemente RJ, Anderson MM, et al. Early drinking onset and its association with alcohol use and problem behavior in late adolescence. Prev Med. 1996; 25:293–300. [PubMed: 8781007]
35. Stueve A, O'Donnell LN. Early alcohol initiation and subsequent sexual and alcohol risk behaviors among urban youths. Am J Publ Health. 2005; 95:887–93.
36. Zakrajsek JS, Shope JT. Longitudinal examination of underage drinking and subsequent drinking and risky driving. J Safety Res. 2006; 37:443–51. [PubMed: 17123546]
37. Donovan JE, Leech SL, Zucker RA, et al. Really underage drinkers: Alcohol use among elementary school students. Alcoholism Clin Exp Res. 2004; 28:341–349.
38. Smith GT, McCarthy DM, Goldman MS. Self-reported drinking and alcohol-related problems among adolescents: Dimensionality and validity over 24 months. J Stud Alcohol. 1995; 56:383–94. [PubMed: 7674672]
39. National Institute on Alcohol Abuse and Alcoholism. Alcohol screening and brief intervention for youth: A practitioner's guide (NIH Publication No 11-7895). Rockville, MD: NIAAA; 2011. Available online at www.niaaa.nih.gov/YouthGuide [Accessed August 1, 2012.]
40. Chung T, Smith GT, Donovan JE, et al. Drinking frequency as a brief screen for adolescent alcohol problems. Pediatrics. 2012; 129:205–12. [PubMed: 22218839]

CONTRIBUTION AND IMPLICATIONS

Normative progression was described for a number of understudied alcohol use behaviors as well as for alcohol problems at ages 8–18. Rates of sipping in childhood and of drunkenness and alcohol problems in adolescence were concerning. Screening is recommended at well-patient visits with referrals for further evaluation if necessary.

Table 1

Mean Ages of Initiation of Alcohol Use Behaviors by Wave 14 and Mean Differences in Initiation Ages[a].

Summary Statistics				Paired-sample Mean Differences				
Behavior	**Mean**	**S.D.**	**n**	**Sipping**	**Drinking**	**3+ Drinks**	**Drunkenness**	**5+ Drinks**
Sipping	11.02	2.22	370	-----				
Drinking	14.60	1.98	209	3.58	-----			
3+ Drinks	16.10	1.51	109	4.97	1.36	-----		
Drunkenness	16.15	1.44	104	4.98	1.45	0.09[n]	-----	
5+ Drinks	16.36	1.31	74	5.17	1.72	0.48	-0.35	-----
2+ Alcohol Problems	16.31	1.35	58	4.76	1.71	0.53	0.49	0.23

Note. Paired-sample means were based on all participants who had initiated both of the compared behaviors. All differences among paired-sample means are significantly different ($p<.05$, two-tailed) by paired-sample *t*-test, except for the single difference indicated by superscript *n*. Positive paired-sample mean differences in the lower diagonal half-matrix indicate that the row behavior mean was larger (older) than the column behavior mean.

[a]Mean age of the sample at Wave 14 was 17.2 (SD = 1.0).

Table 2

Percent of Each Age Group Having Initiated Each Alcohol Use Behavior.[a]

Age	Abstainer	Sipping	Drinking	3+ Drinks	Drunk	5+ Drinks	2+ Alcohol Problems	N
8.0	63.1	36.9	1.5	0.0	0.0	0.0	0.0	65
8.5	61.2	38.8	0.6	0.0	0.0	0.0	0.0	164
9.0	60.2	39.8	1.5	0.0	0.0	0.0	0.0	202
9.5	53.7	46.3	2.0	0.0	0.0	0.0	0.0	197
10.0	49.8	49.5	2.5	0.0	0.0	0.0	0.0	279
10.5	50.9	48.6	2.0	0.0	0.0	0.0	0.0	395
11.0	46.4	53.1	2.8	0.2	0.2	0.2	0.2	422
11.5	39.1	60.2	5.0	0.2	0.2	0.2	0.2	421
12.0	33.2	66.1	7.2	0.5	0.2	0.2	0.2	412
12.5	30.5	68.6	9.0	0.5	0.3	0.3	0.3	406
13.0	27.6	71.2	11.2	1.0	0.5	0.3	0.3	403
13.5	25.1	73.6	15.7	1.7	1.7	0.5	0.3	402
14.0	23.3	75.5	19.1	3.0	2.3	0.8	0.5	396
14.5	21.0	77.3	24.9	5.3	4.3	2.0	1.8	395
15.0	18.7	79.2	29.9	5.8	6.1	2.8	2.5	395
15.5	18.2	80.1	36.6	10.1	9.6	4.8	4.3	395
16.0	15.2	83.1	42.6	15.8	14.7	9.5	6.5	368
16.5	13.3	85.4	50.0	21.3	21.0	12.5	11.8	272
17.0	10.1	88.0	57.3	27.4	27.0	19.5	15.0	226
17.5	7.6	90.4	63.0	30.8	30.9	22.7	18.4	207
18.0	6.7	90.8	67.8	38.2	39.1	28.4	23.2	168
18.5	2.1	95.7	77.8	52.9	55.2	37.9	32.3	65

Note. N is the size of the age group examined in the Latent Class Analyses reported in later tables. Members of the younger age cohort participated at average ages 8.5–16.0. Members of the older cohort participated at average ages 10.5–18.0.

[a]Mid-age rates of drinking (i.e., ages 12.5, 13.5, etc.) are comparable to national ever drinking rates from the 2011 NSDUH [3]: age 12 (6.8%), age 13 (16.3%), age 14 (26.0%), age 15 (41.5%), age 16 (51.8%), and age 17 (61.3%). Rates of ever having 5+ drinks are lower in comparison to 2011 NSDUH rates: ages 12–13 (7.6%), ages 14–15 (16.7%), and ages 16–17 (22.1%) [Source: SAMHDA Quick Tables].

Table 3

Goodness of Fit Statistics for Latent Class Models by Age (BIC = Bayesian Information Criterion, L^2 = Likelihood Ratio Chi-square).

	1-Class Model		2-Class Model		3-Class Model		4-Class Model	
Age	**BIC**	**L^2**	**BIC**	**L^2**	**BIC**	**L^2**	**BIC**	**L^2**
8.5	447.1	218.47	**271.5**	**1.99**	*a*	*a*	*b*	*b*
9.0	577.3	273.30	**348.5**	**2.00**	*a*	*a*	*b*	*b*
9.5	589.4	276.09	**357.6**	**2.01**	*a*	*a*	*b*	*b*
10.0	848.2	387.54	**520.5**	**14.80**	553.1	2.32	*b*	*b*
10.5	1182.3	548.79	**696.7**	**15.36**	731.5	2.32	*b*	*b*
11.0	1362.1	638.12	**831.8**	**59.45**	837.9	17.17	873.5	4.42
11.5	1391.6	622.73	**879.6**	**62.31**	885.1	19.47	918.2	4.31
12.0	1373.7	592.63	**892.0**	**62.80**	896.9	19.49	930.1	4.53
12.5	1353.2	569.34	**898.4**	**66.41**	901.0	21.03	932.6	4.54
13.0	1382.9	561.76	950.9	81.74	**941.3**	**24.14**	971.9	6.80
13.5	1497.8	593.96	1077.1	125.26	**1028.8**	**28.95**	1054.4	6.59
14.0	1570.8	619.75	1152.3	153.43	**1076.7**	**29.89**	1104.0	9.43
14.5	1790.2	718.85	1382.4	263.21	**1216.4**	**49.37**	1235.5	20.68
15.0	1884.5	731.80	1501.4	300.88	**1298.1**	**49.76**	1307.8	11.69
15.5	2161.1	878.22	1736.1	405.36	**1428.3**	**49.74**	1444.8	18.36
16.0	2259.4	931.57	1769.0	393.90	**1499.3**	**76.98**	1490.0	20.37
16.5	1853.9	785.49	1410.4	297.14	**1214.9**	**56.75**	1210.2	7.23
17.0	1641.3	730.43	1175.2	220.88	**1048.6**	**50.98**	1053.1	12.05
17.5	1518.6	667.36	1072.5	178.55	**987.1**	**50.54**	991.7	12.44
18.0	1283.4	557.35	899.8	132.78	**859.7**	**51.66**	869.6	20.60

Note. **Bold** type identifies the best-fitting model (usually lowest BIC). The conditional probabilities in the next table describe the classes comprising the best-fitting models here.

a Statistics not reported as there are no cases in the third class.

b Statistics not reported as there are no cases in the fourth class.

Table 4

Description of the Latent Classes by Age (Conditional Probabilities of Alcohol Use Behaviors Given Membership in Each Latent Class), and Percent of Each Age Group in the Latent Classes by Age.

Latent Class 1 (Abstainers)								
Age	**Abstainer**	**Sipping**	**Drinking**	**3+ Drinks**	**Drunk**	**5+ Drinks**	**2+ Alcohol Problems**	**%**
8.5	**0.9981**	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	61.5
9.0	**0.9961**	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	61.3
9.5	**0.9979**	0.0021	0.0001	0.0000	0.0000	0.0000	0.0000	54.8
10.0	**0.9982**	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	50.5
10.5	**0.9988**	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	51.6
11.0	**0.9987**	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	47.9
11.5	**0.9982**	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	40.4
12.0	**0.9977**	0.0022	0.0002	0.0000	0.0000	0.0000	0.0000	35.0
12.5	**0.9974**	0.0025	0.0003	0.0000	0.0000	0.0000	0.0000	32.6
13.0	**0.9980**	0.0019	0.0003	0.0000	0.0000	0.0000	0.0000	29.5
13.5	**0.9977**	0.0022	0.0004	0.0001	0.0001	0.0000	0.0000	26.9
14.0	**0.9975**	0.0025	0.0006	0.0001	0.0001	0.0000	0.0000	25.3
14.5	**0.9971**	0.0028	0.0009	0.0002	0.0002	0.0001	0.0001	22.8
15.0	**0.9967**	0.0032	0.0012	0.0002	0.0002	0.0001	0.0001	20.3
15.5	**0.9965**	0.0034	0.0015	0.0004	0.0004	0.0002	0.0002	19.8
16.0	**0.9954**	0.0045	0.0023	0.0008	0.0008	0.0005	0.0003	16.6
16.5	**0.9930**	0.0068	0.0040	0.0017	0.0017	0.0010	0.0009	15.1
17.0	**0.9889**	0.0106	0.0070	0.0033	0.0033	0.0023	0.0018	12.0
17.5	**0.9837**	0.0156	0.0110	0.0052	0.0053	0.0039	0.0031	9.3
18.0	**0.9755**	0.0230	0.0175	0.0093	0.0096	0.0069	0.0057	7.9
Latent Class 2 (Sippers/Light Drinkers)								
Age	Abstainer	Sipping	Drinking	3+ Drinks	Drunk	5+ Drinks	2+ Alcohol Problems	%
8.5	0.0049	**0.9951**	0.0000	0.0000	0.0000	0.0000	0.0000	38.5
9.0	0.0039	**0.9961**	0.0255	0.0000	0.0000	0.0000	0.0000	38.7
9.5	0.0031	**0.9969**	0.0336	0.0000	0.0000	0.0000	0.0000	45.2

Latent Class 1 (Abstainers)								
Age	**Abstainer**	**Sipping**	**Drinking**	**3+ Drinks**	**Drunk**	**5+ Drinks**	**2+ Alcohol Problems**	**%**
10.0	0.0019	**0.9837**	0.0434	0.0000	0.0000	0.0000	0.0000	49.5
10.5	0.0014	**0.9882**	0.0366	0.0000	0.0000	0.0000	0.0000	48.4
11.0	0.0011	**0.9898**	0.0454	0.0045	0.0045	0.0045	0.0045	52.1
11.5	0.0008	**0.9872**	0.0756	0.0040	0.0040	0.0040	0.0040	59.6
12.0	0.0007	**0.9882**	0.0969	0.0075	0.0037	0.0037	0.0037	65.0
12.5	0.0006	**0.9848**	0.1094	0.0073	0.0036	0.0036	0.0036	67.4
13.0	0.0004	**0.9995**	0.0946	0.0000	0.0000	0.0000	0.0000	67.0
13.5	0.0003	**0.9787**	0.1708	0.0000	0.0000	0.0000	0.0000	71.0
14.0	0.0003	**0.9821**	0.2004	0.0000	0.0000	0.0000	0.0000	71.3
14.5	0.0003	**0.9748**	0.2446	0.0001	0.0002	0.0001	0.0001	71.0
15.0	0.0002	**0.9683**	0.2930	0.0001	0.0002	0.0000	0.0042	72.2
15.5	0.0002	**0.9815**	0.3474	0.0003	0.0008	0.0001	0.0090	68.6
16.0	0.0002	**0.9842**	0.3928	0.0399	0.0253	0.0001	0.0118	69.3
16.5	0.0003	**0.9942**	0.4513	0.0563	0.0425	0.0002	0.0193	66.2
17.0	0.0003	**0.9858**	0.4897	0.0579	0.0359	0.0004	0.0159	63.1
17.5	0.0002	**0.9843**	**0.5276**	0.0567	0.0404	0.0006	0.0184	62.2
18.0	0.0003	**0.9672**	**0.5332**	0.0674	0.0238	0.0010	0.0120	54.6

Latent Class 3 (Drinkers with Drunkenness)								
Age	Abstainer	Sipping	Drinking	3+ Drinks	Drunk	5+ Drinks	2+ Alcohol Problems	%
13.0	0.0071	**0.6348**	**0.9675**	0.2878	0.1439	0.0720	0.0720	3.4
13.5	0.0105	**0.9875**	**0.9655**	**0.8242**	**0.8242**	0.2355	0.1178	2.1
14.0	0.0061	**0.9926**	**0.9793**	**0.8767**	**0.6576**	0.2193	0.1462	3.5
14.5	0.0030	**0.9964**	**0.9894**	**0.8510**	**0.6889**	0.3243	0.2778	6.2
15.0	0.0023	**0.9973**	**0.9918**	**0.7771**	**0.8104**	0.3719	0.2978	7.5
15.5	0.0014	**0.9538**	**0.9953**	**0.8667**	**0.8206**	0.4122	0.3161	11.7
16.0	0.0010	**0.9410**	**0.9962**	**0.9200**	**0.9149**	**0.6729**	0.4038	14.1
16.5	0.0010	**0.9400**	**0.9966**	**0.9420**	**0.9712**	**0.6685**	**0.5613**	18.7
17.0	0.0007	**0.9459**	**0.9974**	**0.9566**	**0.9946**	**0.7822**	**0.5649**	24.8

Latent Class 1 (Abstainers)								
Age	**Abstainer**	**Sipping**	**Drinking**	**3+ Drinks**	**Drunk**	**5+ Drinks**	**2+ Alcohol Problems**	**%**
17.5	0.0005	**0.9487**	**0.9978**	**0.9428**	**0.9954**	**0.7944**	**0.6032**	28.5
18.0	0.0004	**0.9679**	**0.9983**	**0.9006**	**0.9959**	**0.7437**	**0.6008**	37.5

Note. **Bold** type indicates that class members had a high probability of responding positively on the alcohol use behavior. Very low conditional probabilities indicate that class members had a high probability of responding negatively on the alcohol use behavior (and a low probability of responding positively on the alcohol behavior)

Table 5

Percentage of African American (AA) versus European American (EA) Children in Each Latent Class, by Age.

	Abstainers		Sippers/Light Drinkers		Drinkers With Drunk			
Age	**AA**	**EA**	**AA**	**EA**	**AA**	**EA**	**Wald Test**	***p***
8.5	82.3	56.0	17.7	44.0	-----	-----	6.96	.0084
9.0	80.3	54.9	19.7	45.1	-----	-----	9.80	.0018
9.5	74.4	48.6	25.6	51.4	-----	-----	9.08	.0026
10.0	73.4	43.7	26.6	56.3	-----	-----	16.17	.0001
10.5	67.0	47.0	33.0	53.0	-----	-----	11.03	.0009
11.0	64.0	42.9	36.0	57.1	-----	-----	13.20	.0003
11.5	56.0	35.5	44.0	64.5	-----	-----	12.91	.0003
12.0	50.5	30.2	49.5	69.8	-----	-----	13.06	.0003
12.5	44.1	29.1	55.9	70.9	-----	-----	7.25	.0071
13.0	38.1	27.1	61.9	72.9	-----	-----	4.13	.042
13.5	33.8	24.9	66.2	75.1	-----	-----	2.83	.093
14.0	31.5	23.5	67.3	72.5	1.2	4.1	3.20	.20
14.5	29.6	20.9	66.9	72.1	3.6	7.0	3.61	.16
15.0	26.2	18.6	69.1	73.1	4.7	8.3	3.09	.21
15.5	25.0	18.3	68.0	68.8	7.0	12.9	3.36	.19
16.0	19.6	15.8	73.9	66.8	6.5	17.5	5.08	.079
16.5	18.4	14.2	73.3	63.8	8.3	22.0	5.06	.08
17.0	15.8	10.9	71.2	60.9	13.0	28.2	4.55	.10
17.5	17.6	6.9	66.4	61.1	16.0	32.0	7.01	.030
18.0	14.1	6.2	55.7	54.2	30.2	39.6	2.80	.25

Note. Covariate analyses for ages 13.0 and 13.5 were based on 2-class rather than 3-class results due to only a single AA student reporting 3+ drinks and drunkenness.