Progression through early drinking milestones in an adolescent treatment sample

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ABSTRACT

Aims Research using nationally representative and community samples demonstrates a robust association between early onset of drinking and increased likelihood of numerous adverse outcomes. However, little is known about the subsequent drinking that occurs early in the drinking career. The present study dissects the transition from any alcohol use to treatment entry by taking a fine-grained approach to examining the attainment and progression of drinking events in a sample of adolescents in substance use treatment. Design/Setting Data were taken from the Drug Abuse Treatment Outcome Study for Adolescents (DATOS-A), a multi-site, community-based study of adolescents entering treatment. Participants Respondents included 3331 youth aged 12–18 years (mean = 15.75) admitted to treatment in 1993–95 (74% male, 52% white, 24% African American, 20% Hispanic). Measurements Age of attainment was obtained for five drinking-related milestones, including first drink of alcohol, first time drunk, first monthly drinking, first drank five or more drinks/day on a weekly basis and first drank five or more drinks/day on a daily basis. Findings Most milestones were attained at a very early age, and average progression through adjacent drinking events was relatively swift. Movement through early drinking milestones was accelerated in girls and white youth. Youth who reported their first drink at an early age (age 10 or younger) showed slower progression, suggesting the existence of distinct processes underlying early use and drinking transitions within an individual. Conclusions This study provides data relevant to understanding drinking progression/natural history in a large clinical sample, especially for differences by gender and ethnicity. The findings have implications for the identification of intermediate stages that might benefit from selected intervention programs.

Keywords Adolescent, drinking initiation, milestones, onset of alcohol use, progression, treatment.

INTRODUCTION

Although the legal drinking age in the United States is 21 years, initiation of alcohol use generally occurs well before then. Prevalence of initiating drinking at age 12 or younger ranges from 23.4% to 36.8% across national surveys [1]. Drinking prevalence among ‘tweens’ is alarmingly high, with 9.8%, 16.1% and 29.4% of fourth, fifth and sixth graders, respectively, reporting having tried more than a sip of alcohol [2]. Early alcohol consumption is particularly worrisome, as excessive alcohol use has acute, prolonged neurobiological effects specific to the adolescent brain [3]. In addition, early drinking initiation may interfere with cognitive and social development necessary for healthy functioning [4,5] and may also expose adolescents to risk factors that promote or sustain problem behaviors [6].

Research using nationally representative and community samples has documented associations between early onset of drinking and increased likelihood of short- and long-term adverse outcomes. Early onset is associated with greater alcohol use, problems and alcohol use disorders [7–10]. Early onset also predicts tobacco and other drug involvement [11,12], psychopathology [12], poor school achievement [11], unintentional injury [13], violence [14,15] and suicidality [15,16]. These associations are generally observed even when controlling for demographics, history of substance involvement and normative influences. Based on risks associated with early drinking onset, many researchers conclude that a delay...
in debut age will lead to fewer adverse outcomes. However, some research suggests that the association between early drinking and adverse outcomes is non-causal [17] and may be a manifestation of general vulnerability to behavioral deviance [11].

However, length of time between first drink and a given outcome may not be as informative as drinking behavior during that interval. Although research has characterized the development of alcohol-related problems in adolescents [18,19], only limited work has examined progression through earlier drinking milestones such as regular and heavy alcohol consumption. For youth who become alcohol-dependent and/or end up in treatment, understanding drinking transitions along the way can pinpoint critical opportunities for intervention. We can characterize progression through various landmark events, or ‘milestones’, by exploring the time to attainment of these milestones.

Little attention has focused upon the nature of progression through different drinking events [20]. One exception is work on the telescoping of problematic alcohol use in treatment-seeking women. Progression from use to abuse/dependence is accelerated in women [20–22], with a shorter latency between first or regular use and problematic use/dependence. This has been labeled ‘telescoping’ (a term adopted by the present study), which is not to be confused with ‘forward telescoping’—the tendency to report events to have occurred closer to the assessment than is true [23]. Few studies have examined sex differences in drinking milestones that precede alcohol dependence. Although Piazza et al. [22] found in a treatment sample that women had a shorter interval between first alcohol-related problems and treatment seeking than men, they found no sex difference between the earlier milestones of first drink and first time drunk. Johnson et al. [24] noted that progression between any drinking and drinking to intoxication in a treatment sample was accelerated in women. In that study, progression was also accelerated in blacks, suggesting race differences in telescoping as well. Similarly, Hesselbrock et al. [25] found in alcohol-dependent in-patients that whites had earlier age of first alcohol use but blacks had earlier onset of alcohol problems.

Youth vary both in age of first drink and age of treatment entry. Although early age of first drink confers risk for alcohol dependence, it may not necessarily indicate rapid progression to alcohol dependence. Early age of first drink may be associated with a more rapid uptake, as suggested by work indicating common influences underlying onset and heavy or problematic drinking [17,26]. However, progression (at least, initially) could be slower in those with early initiation due to limited social and physical availability at a young age. In a study exploring progression from first use to alcohol abuse and dependence in a general population sample, more rapid escalation occurred for those with earlier onset (age 11–14) [5]. In contrast, progression from first full drink to alcohol dependence was slower for adolescents with early first drink in high-risk [27] and community samples [28]. There may be a developmental period of risk independent from years of exposure [27,29]. Another study using a high-risk sample demonstrated greater telescoping from first drink to alcohol use disorder among those who began drinking later (≥age 14) [30]; the authors suggest that telescoping is due to the socio-contextual environment of later adolescence with normative peer drinking, accessible alcohol and stronger imitation of adult behaviours, such as heavy drinking. Although early onset may indicate a propensity for problematic alcohol involvement, this propensity may not manifest itself until conducive conditions are present later in adolescence [29]. Examination of the progression from first drink to milestones that precede alcohol dependence would help to pinpoint whether there is a key developmental period of risk.

Overview

The present study dissects the transition from any alcohol use to treatment entry into several smaller transitions by examining the attainment of and progression through five drinking milestones that demonstrate variability in level of risk on the basis of drinking frequency and intensity. Most research on drinking onset has used national or community samples, and research on progression has generally used prospective community or high-risk samples, which is necessary for most of the sample to reach these drinking milestones. However, little is known about the progression of drinking milestones in treated adolescents, who reach these milestones relatively quickly (leading to treatment in adolescence). It is hypothesized that youth with early drinking onset will be more likely to attain milestones but will have a slower rate of accruing milestones. In addition, boys and white youth are expected to have greater likelihood of attaining early milestones, whereas girls and non-white youth are hypothesized to progress more rapidly through the milestones.

METHOD

Participants and procedure

Data were taken from the community-based Drug Abuse Treatment Outcome Study for adolescents (DATOS-A) [31], which was sponsored by the National Institute on Drug Abuse (NIDA) to evaluate treatment effectiveness across short-term in-patient, residential and out-patient programs. The present study draws from two intake interviews separated by 1 week. The first obtained measures of
patient characteristics and behaviors (including substance use); the second assessed psychiatric consequences, behavioral problems and treatment-oriented variables.

Respondents were sampled from among those aged 12–18 years (mean = 15.75; median = 16) admitted to treatment in 1993–95 (n = 3331; 74% male, 52% white, 24% African American, 20% Hispanic). Eight per cent used alcohol daily and 25% met criteria for alcohol dependence; 8.5% (n = 288) abstained from drinking. Age 14 is used as the ‘other’ group is small (4%) and heterogeneous.

Table 1 presents descriptive information for the full sample and for subgroups, including demographics, whether alcohol was a focus of treatment, prior treatment, alcohol and other substance use, diagnosis with life-time alcohol dependence and depression based on criteria from the Diagnostic and Statistical Manual of Mental Disorders (revised 3rd edn) [32] and prevalence of and mean age for reaching each milestone.

Measures

Sex, race and age were assessed at baseline. Age-of-onset information was available for five milestones that occur between first exposure to alcohol and alcohol-related problems/alcohol dependence: first drink more than a sip of alcohol; first got drunk; first drank at least once a month for 6 months or more; first drank five or more drinks at least 1 day a week; and first drank at least five drinks every day for a period of 2 straight weeks. Based on concerns about the validity of responses indicating consumption at an extremely young age, age was bottom-coded as ‘six and under’. For analyses considering age of onset (age of first drink) as a moderator, the variable was coded as early (age 10 or less; 24.6%), moderate (age 11–13; 47.4%) and late (age of first drink) as a moderator, the variable was coded as zero (data were not available to resolve transitions occurred in the same year), course duration was coded as zero (data were not available to resolve transitions at a finer-grained level). Group differences in course duration were tested using GLMs.

Analyses controlled for age at intake to rule out ceiling effects for rapid progression in younger respondents (i.e. those entering treatment at a young age might show rapid progression due to less opportunity to engage in slower drinking progression while young) or for rapid progression in older respondents (i.e. those entering treatment at an older age might show rapid progression because age at intake was censored at age 18). Analyses excluded 51 (1.5%) individuals who reported reaching any milestone at a younger age than age of first drink. Abstainers were included in time-to-attainment analyses but (by virtue of not having met any milestones) were excluded from duration analyses and analyses modeling age of onset.

RESULTS

Time to attainment

Figure 1 shows a graph of hazard and survival functions for each milestone, where survival corresponds to failure to reach the milestone. In addition, the time-point at which the survivor function is 0.50 (the median, a measure of central tendency) is presented. The median age first drink was reached was ~age 12, with a peak
Table 1 Descriptive information on primary variables and related characteristics as well as each of the five drinking milestones presented as percentage or mean (standard deviation), for the full sample and by sex, age of onset and race.

<table>
<thead>
<tr>
<th></th>
<th>Full sample</th>
<th>Boys</th>
<th>Girls</th>
<th>Early onset</th>
<th>Mid onset</th>
<th>Later onset</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (% male)</td>
<td>73.8%</td>
<td>–</td>
<td>–</td>
<td>75.1%</td>
<td>68.6%</td>
<td>76.5%</td>
<td>71.0%</td>
<td>80.6%</td>
<td>75.8%</td>
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<tr>
<td>Age at intake</td>
<td>15.7 (1.4)</td>
<td>15.9 (1.3)</td>
<td>15.3 (1.4)</td>
<td>15.6 (1.4)</td>
<td>15.5 (1.4)</td>
<td>16.3 (1.1)</td>
<td>15.8 (1.3)</td>
<td>15.7 (1.4)</td>
<td>15.7 (1.4)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>White</td>
<td>51.6%</td>
<td>49.6%</td>
<td>57.3%</td>
<td>62.5%</td>
<td>56.4%</td>
<td>45.0%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Black</td>
<td>23.9%</td>
<td>26.0%</td>
<td>17.7%</td>
<td>14.1%</td>
<td>18.8%</td>
<td>30.2%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Hispanic</td>
<td>20.5%</td>
<td>21.1%</td>
<td>19.0%</td>
<td>19.1%</td>
<td>20.4%</td>
<td>21.2%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Alcohol tx focus</td>
<td>31.1%</td>
<td>31.5%</td>
<td>31.7%</td>
<td>39.1%</td>
<td>37.0%</td>
<td>24.8%</td>
<td>40.0%</td>
<td>18.5%</td>
<td>26.0%</td>
</tr>
<tr>
<td>Prior treatment</td>
<td>6.5%</td>
<td>6.0%</td>
<td>7.8%</td>
<td>10.4%</td>
<td>7.1%</td>
<td>4.2%</td>
<td>8.4%</td>
<td>3.5%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Freq. drink-days/month</td>
<td>6.5 (8.9)</td>
<td>7.4 (9.3)</td>
<td>6.2 (8.7)</td>
<td>9.1 (9.9)</td>
<td>7.2 (8.9)</td>
<td>5.3 (8.0)</td>
<td>6.7 (8.5)</td>
<td>5.8 (9.2)</td>
<td>6.7 (9.3)</td>
</tr>
<tr>
<td># Cig. smoke/day</td>
<td>12.1 (10.4)</td>
<td>12.0 (10.3)</td>
<td>12.2 (10.6)</td>
<td>14.2 (11.6)</td>
<td>12.9 (10.1)</td>
<td>10.5 (9.4)</td>
<td>14.2 (10.9)</td>
<td>8.0 (8.3)</td>
<td>11.5 (9.8)</td>
</tr>
<tr>
<td>Freq. use marijuana</td>
<td>6.0 (1.8)</td>
<td>6.1 (1.6)</td>
<td>5.5 (2.1)</td>
<td>6.2 (1.6)</td>
<td>6.1 (1.6)</td>
<td>5.8 (1.8)</td>
<td>6.1 (1.7)</td>
<td>5.7 (1.9)</td>
<td>5.9 (1.8)</td>
</tr>
<tr>
<td>Any drug use</td>
<td>65.2%</td>
<td>63.2%</td>
<td>70.9%</td>
<td>80.0%</td>
<td>70.4%</td>
<td>56.0%</td>
<td>85.0%</td>
<td>21.5%</td>
<td>64.2%</td>
</tr>
<tr>
<td>Alcohol dependence dx</td>
<td>25.4%</td>
<td>22.7%</td>
<td>33.0%</td>
<td>36.7%</td>
<td>30.8%</td>
<td>15.1%</td>
<td>34.1%</td>
<td>11.3%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Depression dx</td>
<td>8.7%</td>
<td>5.9%</td>
<td>16.5%</td>
<td>12.6%</td>
<td>9.0%</td>
<td>6.3%</td>
<td>12.1%</td>
<td>3.6%</td>
<td>5.4%</td>
</tr>
<tr>
<td>First drink: number attained, % attained, age attained</td>
<td>n = 3077</td>
<td>n = 2228</td>
<td>n = 849</td>
<td>n = 745</td>
<td>n = 1435</td>
<td>n = 846</td>
<td>n = 1681</td>
<td>n = 642</td>
<td>n = 625</td>
</tr>
<tr>
<td>Freq. drink-month</td>
<td>6.5 (8.9)</td>
<td>7.4 (9.3)</td>
<td>6.2 (8.7)</td>
<td>9.1 (9.9)</td>
<td>7.2 (8.9)</td>
<td>5.3 (8.0)</td>
<td>6.7 (8.5)</td>
<td>5.8 (9.2)</td>
<td>6.7 (9.3)</td>
</tr>
<tr>
<td>First monthly drink: number attained, % attained, age attained</td>
<td>n = 2704</td>
<td>n = 1944</td>
<td>n = 760</td>
<td>n = 684</td>
<td>n = 1311</td>
<td>n = 701</td>
<td>n = 1588</td>
<td>n = 473</td>
<td>n = 527</td>
</tr>
<tr>
<td>Blood alcohol concentrations</td>
<td>n = 3077</td>
<td>n = 2228</td>
<td>n = 849</td>
<td>n = 745</td>
<td>n = 1435</td>
<td>n = 846</td>
<td>n = 1681</td>
<td>n = 642</td>
<td>n = 625</td>
</tr>
<tr>
<td>Any drug use</td>
<td>65.2%</td>
<td>63.2%</td>
<td>70.9%</td>
<td>80.0%</td>
<td>70.4%</td>
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<td>34.1%</td>
<td>11.3%</td>
<td>18.2%</td>
</tr>
<tr>
<td>First drunk: number attained, % attained</td>
<td>n = 2704</td>
<td>n = 1944</td>
<td>n = 760</td>
<td>n = 684</td>
<td>n = 1311</td>
<td>n = 701</td>
<td>n = 1588</td>
<td>n = 473</td>
<td>n = 527</td>
</tr>
<tr>
<td>First daily HED: number attained, % attained</td>
<td>n = 518</td>
<td>n = 361</td>
<td>n = 157</td>
<td>n = 190</td>
<td>n = 238</td>
<td>n = 88</td>
<td>n = 313</td>
<td>n = 83</td>
<td>n = 98</td>
</tr>
<tr>
<td>First HED: number attained, % attained</td>
<td>n = 518</td>
<td>n = 361</td>
<td>n = 157</td>
<td>n = 190</td>
<td>n = 238</td>
<td>n = 88</td>
<td>n = 313</td>
<td>n = 83</td>
<td>n = 98</td>
</tr>
</tbody>
</table>

Early onset corresponds to age 10 or less; mid onset corresponds to age 11–13; later onset corresponds to age 14 or older for age of first drink. For primary variables and related characteristics, full sample n from 2256 to 3311; boys n from 1671 to 2460; girls n from 557 to 871; early onset n from 503–745; mid onset n from 934 to 1435; later onset n from 571 to 846; white n from 1105 to 1724; black n from 578 to 792; Hispanics n from 456 to 680. Although tests of group differences controlled for covariates (age, sex, age of onset), percentages and means are unadjusted for covariates. All group differences were significant at P < 0.05. There were no sex differences on age at intake or frequency of drinking. The 18.8% of the sample who did not smoke were given a value of 0. A value of 6 reflects 100 to 199 occasions in a year. Value computed only on those who attained the milestone. HED: heavy episodic drinking.
period at age 15. For first time drunk and first monthly drink, the median ages were roughly 14 and the peak period of risk for both was ages 14–16. For both first weekly heavy episodic drinking (HED) and daily HED the peak period of risk was 16, although fewer than 50% of the sample reached these milestones.

Hazard models revealed that the estimated odds of attaining each milestone were greater for girls than for boys. For girls, the odds of having a drink were 1.37 [95% confidence interval (CI): 1.24, 1.50] the odds for boys. Similarly, the odds of getting drunk were 1.14 (95% CI: 1.02, 1.27) greater and the odds of monthly drinking were 1.44 (95% CI: 1.29, 1.60) greater, with boys reaching these milestones roughly 1 year after girls. The odds of weekly HED were 1.34 (95% CI: 1.17, 1.54) greater and the odds of daily HED were 1.40 (95% CI: 1.15, 1.72) greater than the odds for boys.

Hazard models indicated that with each year that first drink was delayed, the estimated odds of attaining the milestones were lower than the odds for these 1 year younger (i.e. those with earlier onset). The hazard odds ratio (OR) for getting drunk was 0.78 (95% CI: 0.77, 0.80); for monthly drinking, OR = 0.82 (95% CI: 0.80, 0.83); for weekly HED, OR = 0.87 (95% CI: 0.86, 0.89); and for daily HED, OR = 0.85 (95% CI: 0.82, 0.87).

The estimated odds of attaining the milestones for black and Hispanic youth were lower than the odds for white youth. The odds ratio for first drink for blacks was 0.43 (95% CI: 0.39, 0.48) and the odds ratio for Hispanics was 0.68 (95% CI: 0.61, 0.76). For getting drunk, OR = 0.44 (95% CI: 0.39, 0.50) for blacks and OR = 0.63 (95% CI: 0.56, 0.72) for Hispanics and for monthly drinking, OR = 0.76 (95% CI: 0.67, 0.86) for blacks. For weekly HED, OR = 0.57 (95% CI: 0.48, 0.68) for blacks and OR = 0.82 (95% CI: 0.70, 0.97) for Hispanics. There was no race difference in the odds of HED on a daily basis.

Figure 2 plots age of attainment (adjusted for covariates) for each milestone by sex, age of onset and race.
Figure 2  Milestone attainment by gender (top left panel; n = 149 for girls, shown in gray; n = 345 for boys, shown in black), age of first drink (bottom left panel; n = 184 for early onset at age 10 or less, shown in light gray; n = 228 for mid onset at age 11–13; shown in medium-gray; n = 82 for later onset at age 14+, shown in black) and race (top right panel; n = 303 for whites, shown in light gray; n = 94 for Hispanics, shown in medium-gray; n = 76 for blacks, shown in black). Values are adjusted means that control for age at interview and (when applicable) gender and age of first drink.
Significant age-of-onset differences in age of attainment were observed, with non-overlapping ages for early milestones but convergence by later milestones, whereby earlier initiating youth ‘caught up’ to later initiating youth. Significant sex differences were observed for age of weekly HED and age of daily HED. Finally, a significant race difference was observed for age of daily HED. Although the figures include only those 494 individuals who attained all drinking milestones (i.e. no censoring), the same patterns were evident if only the first four \( (n = 1148) \), three \( (n = 2188) \) or two \( (n = 2645) \) milestones were considered.

**Duration between milestones**

Next, the hazard of experiencing onset of a given milestone was estimated where time 0 was the time of attainment of the immediately preceding milestone. The milestone of first time drunk was attained by 50% of the sample within 1 year of first drink, with peak periods of early risk (immediately following first drink) and increased risk after 9 years following first drink. A similar pattern was observed for the transition from first time drunk to first monthly drinking. The weekly HED milestone was attained approximately 2 years after first monthly drinking, with relatively uniform risk in the years following, but some evidence of decreased risk at 6 years and increased risk at 8 years. Finally, the daily HED milestone was reached on average 3 years following weekly HED, with some immediate risk within a year of weekly HED, but relatively uniform risk subsequently.

Hazard models revealed that the estimated odds of getting drunk after having a first drink for girls were 1.16 \((95\% \text{ CI}: 1.03, 1.30)\) the odds for boys, and the odds of monthly drinking after getting drunk for girls were 1.42 \((95\% \text{ CI}: 1.24, 1.64)\) the odds for boys, with girls reaching that next milestone 2–3 years sooner than boys. There were no sex differences in the transition from monthly drinking to weekly HED or from weekly HED to daily HED.

With each additional year, the estimated odds of getting drunk after first drink were 1.32 \((95\% \text{ CI}: 1.29, 1.35)\) the odds for those 1 year younger. For the transition from getting drunk to monthly drinking, \( OR = 1.10 \) \((95\% \text{ CI}: 1.07, 1.12)\), and for the transition from monthly drinking to weekly drinking, \( OR = 1.07 \) \((95\% \text{ CI}: 1.04, 1.10)\). For these two milestones, once several years had passed, those with mid-onset age actually progressed to the next milestone faster than those with later onset age. In contrast, those with early onset progressed more rapidly to the last milestone: the odds of daily HED after engaging in weekly HED were 0.95 \((95\% \text{ CI}: 0.91, 0.99)\) the odds for those 1 year younger.

The estimated odds of getting drunk after having a first drink for blacks were 0.43 \((95\% \text{ CI}: 0.38, 0.50)\) the odds for whites, and the odds for Hispanics were 0.61 \((95\% \text{ CI}: 0.53, 0.70)\) the odds for whites; on average, whites reached the first time drunk milestone about 1 year prior to black and Hispanic youth. For the transition from monthly drinking to weekly HED, \( OR = 0.64 \) \((95\% \text{ CI}: 0.53, 0.77)\) for blacks and \( OR = 0.84 \) \((95\% \text{ CI}: 0.70, 0.99)\) for Hispanics. The median time to reach weekly HED was 3 years for whites, 4 for Hispanics and 5 for blacks. Interestingly, odds of daily HED after first weekly HED for blacks were greater than the odds for whites \((OR = 1.38; 95\% \text{ CI}: 1.03, 1.85)\), in contrast to progress among the other milestones, suggesting telescoping of very heavy drinking among blacks. There was no race difference in the interval between first time drunk and first monthly drink.

To complement the survival analyses, the mean interval between pairwise milestones was calculated (see Table 2) for the full sample as well as for respondents \((n = 494)\) who reached all five milestones. Table 3 presents adjusted mean intervals between milestones by sex, age of onset and race. Telescoping is apparent among girls, with more rapid progression to more severe drinking milestones. Those with later onset showed more rapid progression to severe alcohol involvement. Blacks showed shorter intervals, reflecting more rapid progression to severe alcohol involvement, especially compared to whites; Hispanics generally fell in the middle.

**DISCUSSION**

Given the present study’s young sample of heavy alcohol and drug users, most milestones were attained at a very early age. Fifty per cent of the sample reported a first drink by age 12, compared to national surveys, where a much lower proportion of youth (23–37%) reported a first drink by age 12 \([1]\). Although epidemiological studies indicate consistently a peak period of risk for first alcohol use at age 18 \([34]\), the peak period of risk in the present study was around age 15. Average progression through adjacent drinking events was relatively swift, ranging from 1 year (first drink, first time drunk, first monthly drinking) to 3 years (from weekly to daily HED).

Movement through early drinking milestones was accelerated in certain individuals. Although historically the term ‘telescoping’ has referred to an accelerated trajectory from first drink to first alcohol dependence (or first treatment entry) among women, the present study indicates that more rapid progression for females is not necessarily limited to the alcohol dependence landmark. In this clinical sample, girls showed accelerated progression marked by a ‘switch-over’, where girls had later average onset than boys for earlier milestones but earlier onset for later milestones. Girls reached the HED milestones sooner than boys despite sex differences in blood ethanol concen-
trations associated with body mass and body water content. Interestingly, girls were more likely than boys to attain each of the milestones, due perhaps to the high-risk nature of the clinical sample.

The telescoping of drinking among those with later onset in particular was a striking finding. If there is a common factor underlying early use of alcohol and manifestations of alcohol-related problems and alcohol dependence, it does not account for rapid progression to heavier drinking, at least among substance-involved youth in treatment. However, consistent with the age of onset literature, early onsetting youth were more likely to

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Mean interval (in years) between milestones, for the full sample and for the subsample that attained all five drinking milestones.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval</td>
<td>Full sample</td>
</tr>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Drink→drunk</td>
<td>2645</td>
</tr>
<tr>
<td>Drink→monthly</td>
<td>2319</td>
</tr>
<tr>
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<td>1174</td>
</tr>
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</tr>
<tr>
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</tr>
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<td>1170</td>
</tr>
<tr>
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<td>506</td>
</tr>
<tr>
<td>Monthly→weekly HED</td>
<td>1155</td>
</tr>
<tr>
<td>Monthly→daily HED</td>
<td>500</td>
</tr>
<tr>
<td>Weekly HED→daily HED</td>
<td>504</td>
</tr>
</tbody>
</table>

Daily heavy episodic drinking (HED) = first drank five or more drinks per day every day for 2 weeks; drink = first drink of alcohol; drunk = first time drunk; monthly = first drank at least once/month for 6 months; weekly HED = first drank five or more drinks per day at least 1 day a week. SD: standard deviation.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Adjusted mean interval in years between milestones, by sex, age of onset and race.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval</td>
<td>Boys</td>
</tr>
<tr>
<td>Drink→drunk</td>
<td>1.14a (1899)</td>
</tr>
<tr>
<td>Drink→monthly</td>
<td>1.53a (1630)</td>
</tr>
<tr>
<td>Drink→weekly HED</td>
<td>2.25a (832)</td>
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<td>Drink→daily HED</td>
<td>2.66a (354)</td>
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<tr>
<td>Drunk→monthly</td>
<td>0.35a (1535)</td>
</tr>
<tr>
<td>Drunk→weekly HED</td>
<td>1.34a (828)</td>
</tr>
<tr>
<td>Drunk→daily HED</td>
<td>1.98a (351)</td>
</tr>
<tr>
<td>Monthly→weekly HED</td>
<td>1.04a (815)</td>
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<tr>
<td>Monthly→daily HED</td>
<td>1.72a (348)</td>
</tr>
<tr>
<td>Weekly HED→daily HED</td>
<td>0.60a (351)</td>
</tr>
</tbody>
</table>

Daily heavy episodic drinking (HED) = first drank five or more drinks per day every day for 2 weeks; drink = first drink of alcohol; drunk = first time drunk; monthly = first drank at least once/month for 6 months; weekly HED = first drank five or more drinks per day at least 1 day a week. Tests of significance controlled for age at interview as well as age of onset (for sex and race comparisons) and sex (for age of onset and race comparisons). Means with different superscript letters differ significantly (P < 0.05) from each other. SD: standard deviation.
be diagnosed with alcohol dependence (see Table 1). This is also consistent with Sartor et al. [27], who found that high-risk youth with early onset were more likely to be diagnosed with alcohol dependence (17%) than those with later onset (7%), yet showed slower progression (5.9 years versus 1.4 years, respectively). It also replicates Hussong et al. [30], who observed that high-risk youth with later drinking onset had lower risk for developing an alcohol use disorder, but showed accelerated progression. These different findings for likelihood of progressing and rate of progression imply the existence of distinct processes underlying drinking transitions within an individual [35].

Interestingly, whereas whites progressed more rapidly through milestones, the transition from weekly to daily HED was accelerated in blacks. This replicates the finding that blacks began regular alcohol use later than whites but progressed more rapidly to problematic use [24], and is consistent with research indicating that heavy drinking among blacks peaks later and persists longer into adulthood compared to whites [36].

**Possible mechanisms underlying the telescoping effect**

The historical telescoping literature on women offers several explanations for sex differences in progression from first drink to alcohol dependence. Randall et al. [20] hypothesized a biological basis for telescoping whereby women have higher blood alcohol levels due to sex differences in body fat/water proportion and first-pass metabolism. However, McGue [35] notes that differential prediction of likelihood of alcohol dependence versus speed of progression goes against biological explanations for the telescoping effect. Present findings do not support the hypothesis that telescoping is due to women’s earlier recognition of problems leading to earlier treatment seeking [21].

A possible hypothesis underlying the telescoping effect observed among those with late onset is that early onsetting youth may substitute drinking with other drugs, thus delaying progression to heavier drinking. As Table 1 indicates, youth reporting first drink by age 10 had greater substance use. However, early onsets were more likely to drink frequently and were more likely to be alcohol-dependent, suggesting that drug use was supplementing, not replacing, alcohol use. Also contradictory to a drug replacement mechanism is that alcohol was more likely to be a treatment focus for early and mid-onsetters than late onsets.

One of the most critical factors underlying the delay in progression among very early drinkers may be limited opportunity to obtain and consume alcohol. Increased alcohol use and problems in youth are associated with greater alcohol availability, especially access through social sources such as parents, siblings and friends [37]. Later onsetting youth are likely to show greater pubertal development at first drink (by virtue of being older) and hence may have greater access to alcohol, perhaps via older friends/romantic partners. Additionally, the opportunity to consume alcohol is limited by parental monitoring and supervision [38], which is likely to be greater among younger adolescents. Finally, older adolescents may be more likely to be exposed to alcohol content via advertising and the media, which have been shown to influence adolescent alcohol use [39,40], perhaps through peer influence and shaping of alcohol expectancies [40].

Finally, a possible mechanism underlying the telescoping effect is depressive affect. Depression is associated with escalation to heavy drinking [41] and rapid progression from first drink to alcohol dependence [27], due perhaps to negative affect regulation or changes in the underlying neurobiology of the addictive process [21]. Given higher rates of emotional distress among girls [42] and greater rates of depression in the present study, depressive affect may account for telescoping among girls. Given that early onsets had slower progression but were more likely to be depressed, this mechanism may not explain age of onset differences.

**Implications**

The present study distinguished among milestones demarcating drinking stages, characterized the timing of milestone attainment and also identified risk factors specific to the progression through stages. Such nuanced information about early drinking behavior is critical for understanding factors leading to increased risk for development of alcohol dependence and that may be indicative of accelerated risk in those ultimately end up in substance use treatment. This information could be used to design interventions to slow progression to heavy drinking, as opposed to interventions to delay age of first drink, which have shown limited effectiveness [43]. One universal prevention program demonstrated greatest effects for youth who reported already having initiated substance use [43], suggesting some value in intervening immediately after first drink. One promising area is to identify intermediate stages that might benefit from selected intervention. Harm-reduction approaches tailored to stage of alcohol acquisition have been successful [44,45]. Clearly, however, the value of targeted stage-specific approaches lies in the ability to identify risk factors that predict movement among stages [46]. Risk factors for initiation probably differ from risk factors for other transitions along the dimension of adolescent alcohol involvement [2].

The evidence for accelerated progression for certain groups suggests different prevention approaches for dif-
fere different individuals. Approaches may differ with regard to timing: we can identify periods of relative stability during which behaviors can be intervened upon. For example, girls and blacks were more likely to have accelerated progression at the point of very heavy drinking, suggesting the importance of targeting these two groups prior to this stage. Among early onsetting youth who already consumed alcohol there may be opportunities to intervene before progression to more risky drinking, especially in the interval between first drink and getting drunk. The telescoping effect among those with later onset suggests that a critical period of risk [27] may occur during later adolescence, regardless of age of first drink.

Strengths and limitations

The present study has several strengths, including assessment of onset age for several milestones that fall intermediate between first drink and treatment entry. The large national clinical sample permits examination of distinct low-base-rate, high-severity indices of alcohol involvement. Although a population-based study would maximize etiological relevance, a longitudinal design would be necessary to pinpoint specific transitions, as respondents would require time to reach heavier drinking milestones.

The sample’s age heterogeneity (age 12–18 at intake) meant a censored observation period for some individuals. Analyses controlled for age, reducing the likelihood that age accounted for telescoping in later onsetters. In addition, ancillary analyses that stratified the sample on age indicated that telescoping was apparent even among younger youth who would show less biased retrospective report (less ‘forward telescoping’). However, whether findings were an artifact of the young, heavy substance-using clinical sample remains to be seen. Although results may not generalize to all adolescents, the study provides important information on the clinical course/natural history of drinking for youth who may have greater chronicity of alcohol problems, and greater likelihood of engaging in a compulsive drinking pattern. Finally, the present study cannot distinguish between number of years and drinking experience. The assumption here is that youth are drinking more intensely and frequently during a short duration. However, although drinking may be accelerated, fewer years of risk may translate into fewer acute and chronic outcomes.

The study relied upon self-report data and retrospective assessments of ages of milestone attainment. Although self-reported drinking has been shown to be reliable and valid among youth [47], there is recall bias in estimation of dates of particular events [48,49]. However, compared to age-of-onset research using population-based adult samples [7–9], which relies on retrospection over several decades, this sample may have less biased retrospective age-of-onset dating. In addition, participants are reflecting upon relatively nuanced drinking behaviors. However, differential retrospection biases that may be responsible for differences in progression would presumably be constant across milestones.

Data were collected in 1993–95. National data indicate that although prevalence of early onsetting drinking has declined over time, with a corresponding increase in age of initiation from the early 1990s to 2003, the average age of initiation was unchanged for very early onsetters [50]. Younger birth cohorts may show less telescoping than observed here due to later age of first drink, although this may be less true of clinical samples with early onset age.

CONCLUSIONS

The present study demonstrated that in a clinical adolescent sample certain individuals showed rapid progression to heavier drinking, and in doing extends prior research showing accelerated progression from first drink to alcohol dependence among later onsetting drinkers. If the ultimate goal is to develop targeted interventions for early drinkers, it will be important for future research to conduct formal tests of mechanisms underlying these effects.

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Declaration of interest

None.

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