

The persistence of adolescent binge drinking into adulthood: findings from a 15-year prospective cohort study

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ABSTRACT

Objectives: To examine the prevalence of binge drinking in adolescence and its persistence into adulthood in an Australian cohort.

Design: 15-year prospective cohort study.

Setting: Victoria, Australia.

Participants: 1943 adolescents were recruited from secondary schools at age 14–15 years.

Primary outcome measures: Levels of past-week 'binge' drinking (5+ standard drinks on a day, each 10 g alcohol) and 'heavy binge' drinking (20+ standard drinks on a day for males, 11+ for females) were assessed during six adolescent waves, and across three adult waves up to age 29 years.

Results: Half of the males (52%) and a third of the females (34%) reported past-week adolescent binge drinking. 90% of male and 70% of female adolescent-onset binge drinkers continued to binge in young adulthood; 70% of males and 48% of females who were not adolescent-onset binge drinkers reported young adult binge drinking. Past-week heavy bingeing was less common in adolescence than adulthood. Overall, 35% of the sample (95% CI 33% to 38%) reported past-week binge drinking in adolescence and young adulthood and one-third (33%; 30% to 35%) first reported binge drinking in young adulthood; only 7% of the sample (6–8%) had binge drinking in adolescence but not young adulthood. 'Heavy binge' drinking occurred in adolescence and young adulthood for 9% (8% to 10%); 8% (7% to 10%) reported it in adolescence but no longer in young adulthood; and 24% (22% to 26%) began 'heavy binge' drinking in young adulthood. Among adolescent binge drinkers (n=821), young adult binge and heavy binge drinking were predicted by being male, adolescent antisocial behaviour and adverse consequences of drinking in adolescence.

Conclusions: Binge alcohol use is common and persistent among young Australians. Efforts to prevent the onset of binge drinking during adolescence may substantially reduce harmful patterns of alcohol use in young adulthood.

INTRODUCTION

Alcohol is a major source of preventable disease burden among young people¹: it is thought to contribute to 320 000 deaths

ARTICLE SUMMARY

Article focus

- Alcohol is a major source of preventable disease burden among young people.
- Although young people drink less often than adults, they may consume large amounts in a single session ('binge' drinking).
- We aimed to: (1) examine the persistence of adolescent 'binge' and 'heavy binge' drinking from adolescence to young adulthood; (2) examine which characteristics of adolescent binge drinkers predict the persistence of 'binge' and 'heavy binge' alcohol use into young adulthood.

Key messages

- Half of the males and a third of the females in a cohort of young Australians reported past-week binge drinking in adolescence.
- The overwhelming majority of these adolescent binge drinkers continued to binge drink in young adulthood.
- Past-week binge drinking was reported in at least one young adulthood wave by around 70% of males and 48% of females who had not reported past-week binge drinking in adolescence.
- The high rate of persistence of binge drinking into adulthood indicates the need for policies to reduce its onset in adolescence such as limiting availability, increasing costs and discouraging drinking to intoxication.

globally among 15–29 year-olds each year, comprising 9% of all deaths in this group.² The burden attributable to alcohol use as a risk factor among young people aged 15–29 years (20 million disability adjusted life years (DALYs)) is thought to account for one-third of all global alcohol attributable burden (59 million DALYs).³

Alcohol use typically begins in adolescence.^{4–5} Although young people drink less often than adults,⁴ they may consume larger amounts in a single session.^{6–8} Among school students across 14 European countries in

ARTICLE SUMMARY

Strengths and limitations of this study

- This well-conducted prospective study, with very high retention, has provided unique prospective data on the persistence of a prevalent and hazardous drinking pattern into adulthood.
- The following limitations do need to be acknowledged. First, non-response in longitudinal studies is often associated with alcohol and drug use. We used multiple imputation to minimise the impact of this potential bias. Second, our data do not capture the full extent of binge drinking in this cohort because not all binge alcohol use will have been captured within the 1 week reference period. Both these limitations mean that if anything, our findings on levels of binge drinking are conservative in estimating total exposure to these levels of drinking overall and over time.
- Third, all data were based on self-report; however, there is reasonable evidence that young people's reports of alcohol use are reliable and valid when they are made in a confidential manner, and without any consequences for disclosing.
- Fourth, we used the same definition of binge and heavy binge drinking in adolescent and young adults. It is likely that the same amount of alcohol will have a greater adverse impact on adolescents than on adults.

2011, 41% reported past-month 'binge' drinking (5+ standard alcoholic drinks⁹); levels in the UK were 54%.⁹ Similar drinking levels occur in young Australians.¹⁰ One in five Australian males and females 16–24 years reported drinking 20+ and 11+ standard drinks in a session (each 10 g alcohol), respectively, at least monthly in the past year.¹¹

There have been many studies examining alcohol use among adolescents,^{12–13} risk factors for young adult consumption and alcohol use disorders,^{14–19} and the impact of adolescent use upon health in young adulthood.¹³ However, to our knowledge there has not been a study of the course of adolescent binge drinking in a cohort study of young Australians.²⁰ We investigated the persistence of binge drinking into adulthood among Australian young people using a 15-year prospective cohort study of young Australians that assessed alcohol use during adolescence and up to age 29 years. We also examined the predictors of persistence of binge alcohol use into young adulthood among adolescent binge drinkers.

We aimed to

1. Examine the persistence of adolescent 'binge' and 'heavy binge' drinking from adolescence to young adulthood;
2. Examine which characteristics of adolescent binge drinkers predict the persistence of 'binge' and 'heavy binge' alcohol use into young adulthood.

METHODS

Sample

Between August 1992 and 2007, we conducted nine waves of interviews with a cohort then resident in the

state of Victoria, Australia (for more details see refs. 21 22). At the beginning of the adolescent phase (waves 1 and 2), parental consent was obtained; in adult waves, participants were informed in writing and gave verbal consent.

At baseline, a representative sample of the Victorian population of school pupils aged 14–15 years (year 9) was recruited. Retention in school to year 9 among Victorian young people in 1992–1993 was 98%. A two-stage cluster sampling procedure was used, with two classes selected at random. At stage 1, 45 schools were randomly chosen from a stratified frame of government, Catholic and independent private schools. At stage 2, one class was selected at random from each participating school, entering in the last part of year 9 (wave 1), followed by a second class in the second wave 6 months later (wave 2). Participants were interviewed at 6-month intervals from 14 to 19 years (waves 3–6) with three waves in young adulthood: 20–21 years (wave 7), 24–25 years (wave 8) and 28–29 years (wave 9). In waves 1–6, participants self-administered the questionnaire on laptops, with telephone follow-up of those absent from school; waves 7–9 involved computer-assisted telephone interviews.²³

Measures

Alcohol consumption

Alcohol consumption was recorded at all adolescent and adult phases in an alcohol diary by any participants who reporting drinking in the previous week. In the adolescent phase, respondents completed a 7-day alcohol diary. In the adult phase, in order to minimise respondent burden, participants were only asked to complete a 4-day diary including all weekend days (Friday to Sunday) and the most recent weekday. Types of alcohol (beer, cider, spirits, mixed drinks, wine, etc), brand names and the amounts consumed (glass, pint, bottle, can, etc) were recorded. We calculated the number of standard drink units (10 g alcohol) consumed on each day/occasion, and at each wave. Two measures of binge drinking were estimated (using the same definition in adolescent and adult phases).

1. '*Binge drinking*': Defined (at each wave) as having drunk five or more standard drinks (each 10 g alcohol) on at least 1 day during the diary week. *Any binge drinking* was defined in adolescence and adulthood as binge drinking on one or more waves during the respective phase. For each phase, we identified the number of waves in which binge drinking occurred: none, one wave and two or more waves (in adolescence, 2+ of five assessment waves; in adulthood, 2+ of three waves). *Persistent binge drinking* was defined as binge drinking on two or more waves.
2. '*Heavy binge drinking*': Defined as having drunk >20 standard drinks for males and ≥11 standard drinks for females on any day over the diary week.¹¹ These levels were taken from a previous study of young people,¹¹ using the Australian National Health and Medical Research Council definitions of 'high risk'

drinking for males and females. Any 'heavy' binge drinking in adolescence and adulthood was defined as having done so on any wave. The number of waves in each phase was identified as above. *Persistence of 'heavy' binge drinking* was defined as drinking at this level on two or more waves (adolescence, 2+ of five waves; adulthood, 2+ of three waves).

Incident binge drinking was defined as first reporting binge or heavy binge drinking in young adulthood. *Continuity of binge drinking* and of *heavy binge drinking* was defined as the same pattern of drinking in adolescence and also adulthood. *Discontinuity* was defined as adolescent binge or heavy binge drinking without binge/heavy binge drinking in young adulthood.

Prognostic factors

Adolescent tobacco smoking was assessed at each adolescent wave. Participants who reported smoking daily in the week prior to survey at any one adolescent wave were classified as daily smokers during adolescence.

Adolescent cannabis use was assessed using the reported frequency of use in the previous 6 months at each wave. Maximal cannabis use during the adolescent phases (ie, most frequent level reported across any wave) was categorised as *none/occasional* and *daily/weekly*.

Adolescent antisocial behaviour was assessed using 10 items from the Moffitt and Silva self-report early delinquency scale,²⁴ which assessed property damage, interpersonal conflict and theft. Participants were asked if they had engaged in any of these behaviours *never, once or more than once* in the last 6 months. *Antisocial behaviour* was defined as any antisocial behaviour on more than one adolescent wave, and/or 2+ behaviours in the same wave.

Early onset sexual behaviour: participants were asked if they had ever had sex ('gone all the way' or had sexual intercourse) at each adolescent wave and their age of first sex at each young adulthood wave. Those reporting sexual activity before 16 years were classified as *early onset sexually active*.

Adolescent mental health was assessed using the Clinical Interview Schedule (CIS-R),²⁵ which assesses depression and anxiety in non-clinical populations; a cut-off of >11 defines a mixed depression-anxiety state requiring clinical intervention. Mental health problems were summarised as having occurred: never, in one or 2+ adolescent waves.

Adolescent alcohol-related consequences: Eight questions were asked about problems related to alcohol over the past 6 months in all adolescent waves. These were categorised into four types of consequences: intense drinking (drank so much that the next day you could not remember what you said/did); alcohol-related social problems (lost friends, had trouble at school or argued with family, because of drinking); alcohol-related injury, accident or violence (violent and had a fight or had an injury or an accident, because of drinking); and alcohol-related sexual risk taking (had sex without using

contraceptives, had sex without using protection or had sex and regretted it, because of drinking). For each of the four types of consequences, persistence in adolescence was defined as engaging in the behaviour either across multiple waves or more than once on one wave.

Statistical analysis

We calculated the prevalence of binge drinking at each wave and the number of waves on which each type of binge drinking occurred in adolescence and adulthood. We also estimated the continuity and discontinuity of binge and heavy binge drinking between the two phases. Among those reporting adolescent binge drinking (n=821), logistic regression was used to examine the prognosis for this group in terms of binge drinking. We investigated associations between adolescent predictors and any binge and heavy binge drinking in young adulthood. These associations were initially examined separately and then jointly in multivariable models. Interactions between the adolescent predictors and sex were examined in the multivariable models but the evidence for differential sex effects was weak. In order to retain information from individuals with incomplete data (and thereby minimise the effects of participation bias), the prevalence of binge and heavy binge drinking during adolescent and young adult phases was estimated using multiple imputation^{26 27} (see online supplementary appendix). All data analysis was undertaken using Stata V.12.²⁸

Role of the funding source

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RESULTS

From a total of 2032 students, 1943 (95.6%) participated at least once in adolescence (figure 1); 1756 (53% female) participated in at least one adult wave and were known to be alive at wave 9; 1282 completed all three adult waves; 293 completed two waves, and 181 completed one wave. By the end of wave 9, nine participants were known to have died, 108 lost to follow-up and 319 refused participation; 1501 participants were interviewed, 1407 of whom did the full (1383) or part²⁴ interview schedule and 94 a paper questionnaire. In this paper, we only used adolescent data from waves 2–6 as over half of the adolescents did not participate in wave 1.

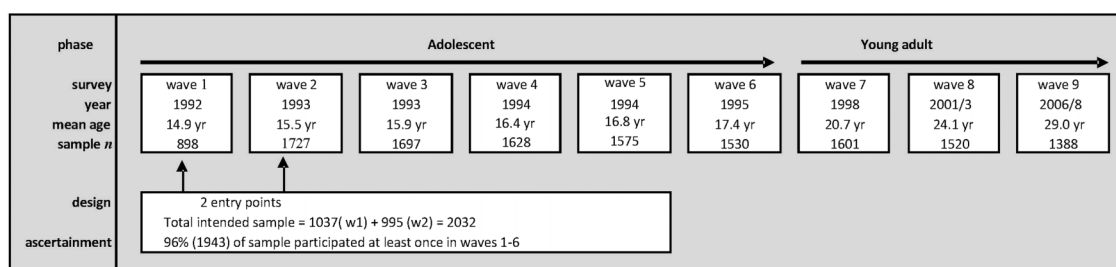


Figure 1 Sampling and ascertainment in the Victorian Adolescent Health Cohort, 1992–2008.

The analysis utilised data from waves 2 to 9 for all participants ($n=1934$) who completed the survey at least once in adolescence (waves 2–6) and were alive at wave 9, with multiple imputation used for incomplete records. The results from the available case analyses are presented in the online supplementary appendix; the pattern of results was broadly similar compared to the imputed data.

Past-week binge drinking

Almost seven in eight males and two-thirds of the females reported binge drinking in the last week on at least one wave in adolescence and young adulthood. Nearly half of the males and a quarter of the females reported binge drinking both in adolescence and young adulthood. The overwhelming majority of adolescent-onset binge drinkers (9 in 10 male and 7 in 10 female adolescent-onset binge drinkers) continued to binge drink in young adulthood (table 1). The number of young adult binge drinkers was increased by incident binge drinking among those who did not report binge drinking in adolescence: one-third of the males and females. Only 4.4% of males and 9.5% of females who were adolescent binge drinkers did not report binge drinking in adulthood.

Past-week binge drinking (5+ standard drinks of 10 g alcohol on a day) across adolescence (figure 2A) increased in males from 14.4% in wave 2 (mean age 15.5 years) to 31.1% in wave 6 (17.4 years) and in females from 7.6% to 15.0%. Persistent adolescent past-week binge drinking (across 2+ adolescent waves) was reported by one in three males (31.8%) and one in seven females (15.3%; table 1). In the adult waves, the prevalence of binge drinking was higher for males and females than in the adolescent phase and levels consumed by males were higher than those by females. In adulthood (table 1 and figure 2A), over 80% of males reported binge drinking on at least one adult wave and more than half of the females did so. Six in 10 (59.1%) males and one in four (24.5%) females reported binge drinking across multiple adult waves (table 1).

Past-week heavy binge drinking

Just under half of the males (45.6%) and a third of the females (36.2%) reported past-week heavy binge drinking at least once during adolescence or young

adulthood (table 2). Sixty-one per cent of males and 42% of females who reported heavy binge drinking in adolescence continued into young adulthood. Of those who engaged in heavy binge drinking at any wave, 58% first reported doing so in young adulthood.

During adolescence, males and females reported similar levels of heavy binge use at each wave but males (7.9%) were more likely to report heavy binge drinking on multiple adolescent waves than females (4.7%; table 2). Past-week heavy binge drinking did not increase substantially until the young adult waves (figure 2B). Around two in five males and one in four females reported past-week heavy binge drinking on at least one adult wave (table 2). At ages 20 and 24 years, around 20% of males and 13% of females reported heavy binge drinking. There was a decline in past-week heavy binge drinking by age 29 years.

Young adult binge and heavy binge alcohol use among adolescent-onset binge drinkers

Levels of past-week binge and heavy binge drinking in adulthood, among adolescent-onset binge and heavy binge drinkers, are presented in figure 3. Males with adolescent-onset binge drinking were more likely to continue binge drinking in adulthood than females (figure 3A): around 7 in 10 males reported doing so, compared to fewer than half of the females. By 29 years, female adolescent-onset binge drinkers had substantially lower levels of binge drinking than in earlier waves, and much lower levels than males. Levels of adult heavy binge drinking did not differ markedly by sex among adolescent-onset binge drinkers; around 20–30% reported past-week heavy binge drinking at ages 20 and 24, with lower levels at 29 years (wave 9; figure 3A). Among adolescent-onset heavy binge drinkers, the patterns and levels followed a similar sex pattern to that in adolescent-onset binge drinkers (figure 3B).

Table 3 reports associations between adolescent characteristics and binge and heavy binge drinking at any adult wave in adolescent-onset binge drinkers ($n=821$). At a univariate level, being male and reporting adolescent antisocial behaviour or negative consequences of alcohol use in adolescence were associated with the reporting of young adult binge and heavy binge drinking in the past week. In multivariable analyses that included all covariates, the associations between adult

Table 1 Past week binge drinking during adolescence and young adulthood, by sex

	Binge drinking in the past week								
	Males (N=935)			Females (N=999)			Total (N=1934)		
	n	Per cent	(95% CI)	n	Per cent	(95% CI)	n	Per cent	(95% CI)
<i>Adolescent phase (waves 2–6)</i>									
Binge drinking by wave									
Wave 2 (mean age 15.5 years)	135	14.4	(12.1 to 16.7)	76	7.6	(5.90 to 9.30)	211	10.9	(9.50 to 12.3)
Wave 3 (mean age 15.9 years)	170	18.1	(15.5 to 20.7)	96	9.6	(7.50 to 11.7)	265	13.7	(12.1 to 15.4)
Wave 4 (mean age 16.4 years)	208	22.3	(19.3 to 25.3)	140	14.1	(11.8 to 16.3)	349	18.0	(16.2 to 19.9)
Wave 5 (mean age 16.8 years)	265	28.3	(25.1 to 31.5)	152	15.2	(12.9 to 17.6)	417	21.6	(19.6 to 23.5)
Wave 6 (mean age 17.4 years)	291	31.1	(28.0 to 34.3)	150	15.0	(12.6 to 17.4)	441	22.8	(20.8 to 24.8)
Number of adolescent waves of any binge drinking									
Never	453	48.5	(45.0 to 52.0)	660	66.1	(63.0 to 69.1)	1113	57.6	(55.2 to 60.0)
1 wave	184	19.7	(16.8 to 22.6)	186	18.6	(16.0 to 21.2)	370	19.1	(17.1 to 21.1)
2+ waves	297	31.8	(28.5 to 35.1)	153	15.3	(13.0 to 17.7)	451	23.3	(21.3 to 25.3)
<i>Young adult phase (waves 7–9)</i>									
Binge drinking by wave									
Wave 7 (mean age 20.7 years)	509	54.5	(51.1 to 57.9)	318	31.8	(28.7 to 34.9)	827	42.8	(40.4 to 45.1)
Wave 8 (mean age 24.1 years)	550	58.8	(55.2 to 62.4)	335	33.5	(30.3 to 36.7)	885	45.8	(43.3 to 48.2)
Wave 9 (mean age 29.0 years)	524	56.1	(52.3 to 59.8)	233	23.3	(20.2 to 26.4)	757	39.2	(36.6 to 41.8)
Number of adult waves of any binge drinking									
Never	178	19.1	(16.2 to 21.9)	437	43.8	(40.4 to 47.1)	616	31.8	(29.6 to 34.1)
1 wave	204	21.8	(18.9 to 24.8)	316	31.7	(28.4 to 35.0)	521	26.9	(24.7 to 29.1)
2+ waves	552	59.1	(55.7 to 62.5)	245	24.5	(21.5 to 27.6)	798	41.2	(38.8 to 43.7)
<i>Continuity and discontinuity from adolescence (waves 2–6) to young adulthood (waves 7–9)</i>									
None in either phase	137	14.7	(12.2 to 17.2)	342	34.2	(31.0 to 37.5)	479	24.8	(22.7 to 26.9)
Incident in young adulthood	316	33.8	(30.3 to 37.3)	318	31.9	(28.7 to 35.0)	634	32.8	(30.4 to 35.2)
Remitted by young adulthood (adolescence only)	41	4.4	(2.80 to 6.00)	95	9.5	(7.50 to 11.6)	136	7.1	(5.80 to 8.30)
Continuing in young adulthood (both phases)	441	47.1	(43.5 to 50.7)	244	24.4	(21.6 to 27.2)	684	35.4	(33.1 to 37.7)

'Binge' drinking defined as five or more drinks in 1 day in the past week.

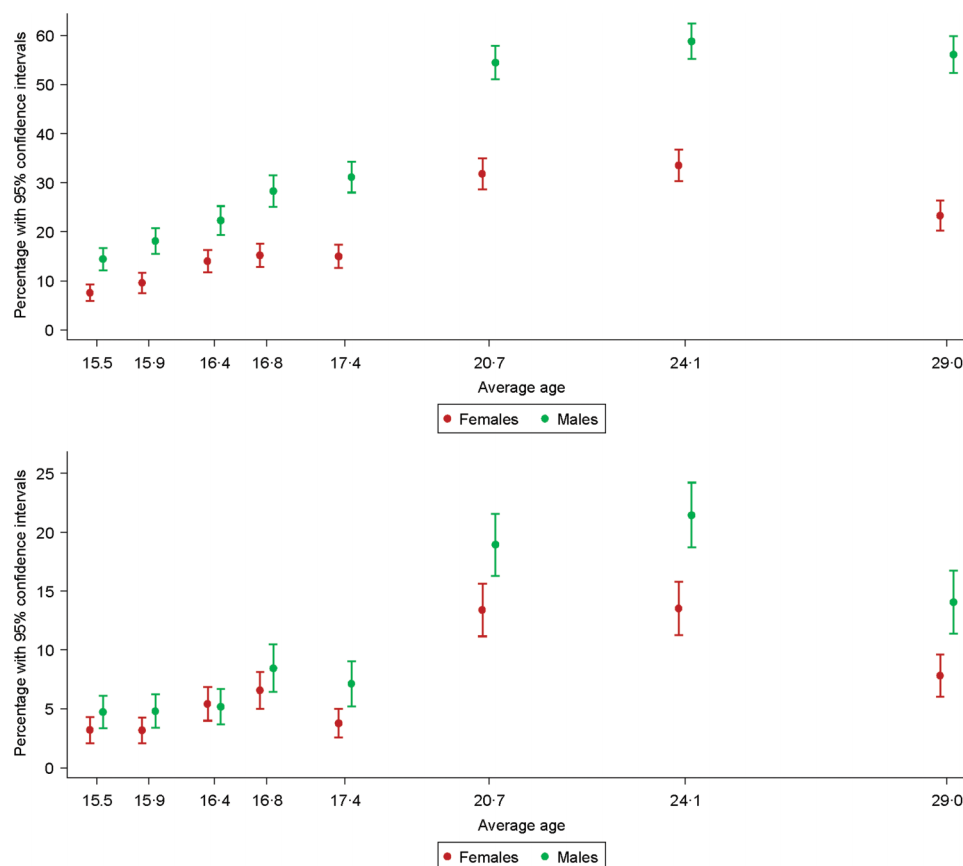


Figure 2 (A) Levels of past week binge alcohol use among males and females (5 or more standard drinks on a day in the past week) by age. (B) Levels of past week 'heavy binge' alcohol use among males and females (11 or more standard drinks on a day in the past week for females, 20 or more for males) by age.

bingeing and female gender were substantially unchanged (for young adult binge OR 0.23, 95% CI 0.13 to 0.40; for young adult heavy binge use OR 0.63, 95% CI 0.43 to 0.92). Associations with behavioural characteristics were substantially attenuated when adjusted for sex and other characteristics, with the strongest independent effect being an increase in the odds of young adult binge drinking if sexual risk taking had occurred in adolescence.

DISCUSSION

Consistent with the cross-sectional surveys in England,²⁹ the USA and Europe,^{5,9} binge drinking was highly prevalent in both sexes and normative in young Australian males. A substantial minority also engaged in heavy binge drinking (drinking more than 20 drinks on an occasion). Over half of the males and a third of the females reported binge drinking in the past week at some time during adolescence, and one in five males and one in seven females reported what we defined as 'heavy binge drinking'.

The overwhelming majority of those who reported binge drinking in adolescence continued to do so in young adulthood. Even if past-week binge drinking was not reported in the teens, it was reported in at least one

wave in young adulthood by 70% of males and 48% of females who did not report binge drinking at any time in adolescence. Interestingly, our findings about the continuity of past-week binge drinking from adolescence to young adulthood contrasted somewhat with the findings of a Norwegian cohort study, where considerable discontinuity was observed, and where they estimated that eliminating all adolescent hazardous drinking would only reduce adult hazardous drinking by 10%.³⁰

Among those who reported binge drinking in adolescence, variables that predicted binge and heavy binge drinking in young adulthood included: regular (weekly+) cannabis use, antisocial behaviour and early onset sexual activity. The most consistent predictors of adult binge and heavy binge drinking were reporting adverse consequences of alcohol use in adolescence, namely 'intense drinking' (could not remember the night before because of drinking), social problems, sexual risk taking and physical harm. Adolescent binge drinkers who engaged in other risky behaviours, and who had experienced negative consequences of alcohol use, were most likely to continue drinking at these levels in adulthood. In multivariable regression analysis, the strongest independent predictor of adult binge drinking among adolescent binge drinkers was being male.

Table 2 Past week heavy binge drinking during adolescence and young adulthood, by sex

	Heavy binge drinking in the past week								
	Males (N=935)			Females (N=999)			Total (N=1934)		
	n	Per cent	(95% CI)	n	Per cent	(95% CI)	n	Per cent	(95% CI)
<i>Adolescent phase (waves 2–6)</i>									
Heavy binge drinking by wave									
Wave 2 (mean age 15.5 years)	44	4.8	(3.40 to 6.10)	32	3.2	(2.10 to 4.30)	77	4.0	(3.10 to 4.80)
Wave 3 (mean age 15.9 years)	45	4.8	(3.40 to 6.20)	32	3.2	(2.10 to 4.30)	77	4.0	(3.10 to 4.90)
Wave 4 (mean age 16.4 years)	49	5.2	(3.70 to 6.70)	54	5.4	(4.00 to 6.90)	103	5.3	(4.30 to 6.30)
Wave 5 (mean age 16.8 years)	79	8.5	(6.40 to 10.5)	66	6.6	(5.00 to 8.10)	145	7.5	(6.20 to 8.80)
Wave 6 (mean age 17.4 years)	67	7.1	(5.20 to 9.00)	38	3.8	(2.60 to 5.00)	105	5.4	(4.30 to 6.50)
Number of adolescent waves of any heavy binge drinking									
Never	755	80.7	(78.1 to 83.4)	847	84.7	(82.5 to 87.0)	1601	82.8	(81.1 to 84.5)
1 wave	106	11.4	(9.10 to 13.6)	106	10.6	(8.60 to 12.5)	212	11.0	(9.50 to 12.4)
2+ waves	74	7.9	(6.10 to 9.70)	47	4.7	(3.30 to 6.00)	121	6.2	(5.10 to 7.30)
<i>Young adult phase (waves 7–9)</i>									
Heavy binge drinking by wave									
Wave 7 (mean age 20.7 years)	177	18.9	(16.3 to 21.6)	134	13.4	(11.2 to 15.6)	311	16.1	(14.4 to 17.8)
Wave 8 (mean age 24.1 years)	201	21.4	(18.7 to 24.2)	135	13.5	(11.3 to 15.8)	336	17.4	(15.6 to 19.1)
Wave 9 (mean age 29.0 years)	132	14.1	(11.4 to 16.7)	78	7.8	(6.10 to 9.60)	210	10.8	(9.30 to 12.4)
Number of adult waves of any heavy binge drinking									
Never	579	62	(58.7 to 65.3)	726	72.7	(69.7 to 75.6)	1305	67.5	(65.2 to 69.7)
1 wave	230	24.6	(21.4 to 27.8)	212	21.2	(18.5 to 23.9)	442	22.8	(20.7 to 25.0)
2+ waves	125	13.4	(10.9 to 15.9)	62	6.2	(4.60 to 7.70)	187	9.7	(8.20 to 11.1)
<i>Continuity and discontinuity from adolescence (waves 2–6) to young adulthood (waves 7–9)</i>									
None in either phase	508	54.4	(50.9 to 57.8)	638	63.8	(60.7 to 66.9)	1146	59.2	(56.9 to 61.6)
Incident in young adulthood	247	26.4	(23.3 to 29.5)	209	20.9	(18.3 to 23.5)	456	23.6	(21.5 to 25.6)
Remitted by young adulthood (adolescence only)	71	7.6	(5.80 to 9.50)	88	8.8	(7.00 to 10.7)	160	8.2	(6.90 to 9.60)
Continuing in young adulthood (both phases)	109	11.6	(9.30 to 14.0)	64	6.4	(4.80 to 8.10)	173	9.0	(7.60 to 10.3)

'Heavy binge' drinking defined as >11 drinks on a day in the past week for females, >20 for males. Persistent 'heavy binge' drinking in adolescence defined as heavy binge drinking in the past week on two or more waves across the adolescent waves (waves 2–6).

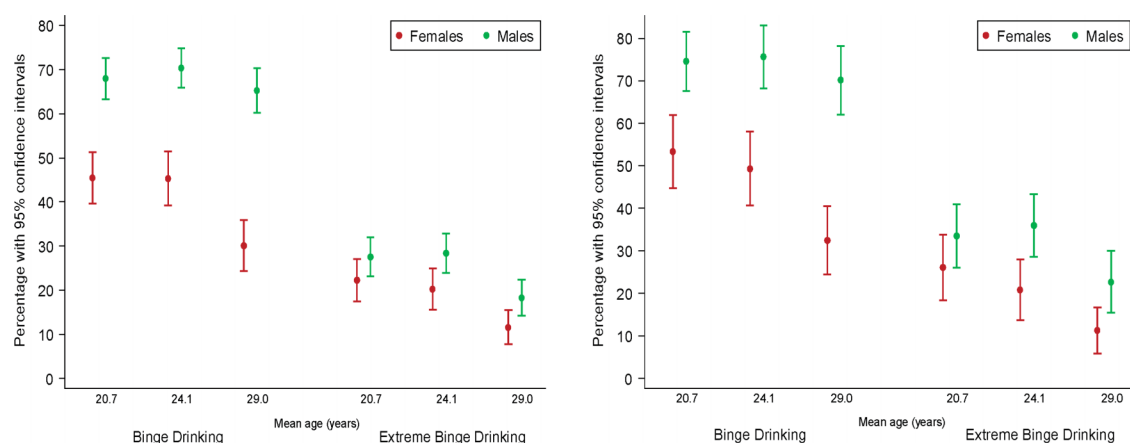


Figure 3 (A) Levels of past week binge and 'heavy binge' drinking for males and females who reported binge drinking at one or more waves in adolescence, by age. (B) Levels of past week binge and 'heavy binge' drinking for males and females who reported 'heavy binge' drinking at one or more waves in adolescence, by age.

Limitations

The following limitations need to be acknowledged. First, non-response in longitudinal studies is often associated with alcohol and drug use. We used multiple imputation to minimise the impact of this potential bias, but this method carries its own assumptions and it is difficult to assess exactly how much residual bias might remain. The method of multiple imputation also assumes that data were missing at random. This is unlikely to be strictly true, but the method is strengthened by the inclusion of auxiliary variables in the imputation model.

Second, our data do not capture the full extent of binge drinking in this cohort because not all binge alcohol use will have been captured within the 1 week reference period. Both these limitations mean that our findings on levels of binge drinking may underestimate total exposure to these levels of drinking overall and over time.

Third, all data were based on self-report. There is reasonable evidence that young people's reports of alcohol use are reliable and valid when they are made in a confidential manner and without any consequences for disclosing use (as was the case here).^{31 32}

Fourth, we used the same definition of binge and heavy binge drinking in adolescents and young adults. It is quite likely that the same amount of alcohol will have a greater adverse impact on adolescents than on adults. Notwithstanding these limitations, this study has provided unique prospective data on the persistence of a prevalent and hazardous drinking pattern from adolescence into adulthood.

We have clearly identified that binge alcohol use is a common behaviour among adolescents, and that it is likely to persist into young adulthood. These patterns of binge drinking in adolescence are a public health concern for two reasons. First, heavy alcohol use substantially increases the risks of: motor vehicle accidents, other injuries, alcohol-related assaults and suicides in

young people.³³ Second, the longer-term health effects of persistent binge drinking during adulthood include alcohol dependence, liver disease and cancer. In most adolescent binge drinkers, binge drinking was clearly not just an 'adolescent phase'; it was a pattern that persisted into young adulthood. There is an urgent need to understand why such high levels of alcohol use in adolescence continue into young adulthood.

Social acceptability, ready availability and low cost of alcohol are likely to be important drivers of early initiation into binge drinking and continuing high levels of consumption. Both the taste³⁴ and packaging³⁵ of premixed drinks are particularly attractive to young people; exposure to some forms of advertising is also associated with increased consumption,³⁶ as are increased numbers of outlets selling alcohol,^{37–39} extended opening hours^{40 41} and reduced alcohol taxes^{40 42} (though only applied similarly across products.⁴³) The *persistence* of binge drinking into young adulthood may also be related to a delay in 'maturing out' of drinking as a result of the postponement in recent cohorts of major social role transitions such as marriage and parenthood into later adulthood.⁴⁴

CONCLUSIONS

Alcohol is one of the biggest risk factors for disease burden among young people. Heavy consumption in young people is common and persistence into young adulthood is much more likely than not. There is a need to develop interventions that explicitly acknowledge that prevention confined to adolescence alone is insufficient. Clearly, there is much work still to be carried out in that area, given the incredibly high exposure not only to *any* alcohol use, but also to binge alcohol use across the adolescent years, often repeatedly. It is also apparent that there is work to be carried out in young adulthood since most of the heavy binge drinking began then, once participants were legally allowed to drink, and past the age at which most prevention

Table 3 Predictors of binge alcohol use in young adulthood among adolescent 'binge' alcohol drinkers (ie, those who had past-week binge drinking on at least one wave during adolescence, waves 2–6; n=821)

	Young adult 'binge' drinking				Young adult 'heavy binge' drinking			
	Modelled separately		Modelled jointly		Modelled separately		Modelled jointly	
Adolescent predictors among adolescent 'binge' drinkers, n=821:	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Female	0.24	(0.15 to 0.39)	0.23	(0.13 to 0.40)	0.67	(0.49 to 0.92)	0.63	(0.43 to 0.92)
Daily smoking	1.20	(0.79 to 1.81)	1.12	(0.69 to 1.82)	1.29	(0.94 to 1.77)	1.01	(0.70 to 1.46)
Weekly/daily cannabis use	1.65	(0.96 to 2.82)	1.05	(0.54 to 2.03)	1.57	(1.11 to 2.24)	1.06	(0.71 to 1.60)
Antisocial behaviour	1.70	(1.12 to 2.59)	0.99	(0.60 to 1.63)	1.59	(1.16 to 2.18)	1.06	(0.74 to 1.52)
Early onset sexual activity (<16 years)	1.46	(0.92 to 2.33)	1.04	(0.60 to 1.83)	1.53	(1.09 to 2.14)	1.02	(0.69 to 1.49)
Adolescent mental health problems								
CIS >11, 0 waves	1		1		1		1	
CIS >11, 1 wave	0.81	(0.42 to 1.57)	0.90	(0.44 to 1.81)	1.23	(0.81 to 1.87)	1.15	(0.74 to 1.77)
CIS >11, 2+ waves	0.60	(0.37 to 0.97)	0.83	(0.48 to 1.46)	1.05	(0.74 to 1.49)	0.99	(0.64 to 1.52)
Adolescent consequences attributed to alcohol use								
Intense drinking*	1.54	(1.00 to 2.36)	1.45	(0.84 to 2.50)	1.77	(1.28 to 2.43)	1.41	(0.99 to 2.00)
Social problems†	1.34	(0.85 to 2.10)	1.25	(0.72 to 2.18)	1.63	(1.16 to 2.31)	1.23	(0.83 to 1.83)
Physical harm‡	1.92	(1.13 to 3.26)	1.25	(0.64 to 2.44)	1.96	(1.37 to 2.81)	1.29	(0.84 to 1.96)
Sexual risk taking§	1.75	(1.01 to 3.03)	1.51	(0.77 to 2.97)	2.09	(1.44 to 3.03)	1.64	(1.07 to 2.53)

'Binge' drinking defined as five or more drinks in 1 day in the past week. 'Heavy binge' drinking defined as >11 drinks in 1 day in the past week for females, >20 for males. Note that 21–22 years=wave 7; 24–25 years=wave 8; 28–29 years=wave 9.

*Could not remember what said or did the night before as a result of alcohol use.

†Lost friends, school trouble, argued with family as a result of alcohol use.

‡Injuries, accidents, violence attributed to their alcohol use.

§Regretted having sex, or had sex without protection or contraceptives as a result of alcohol use.

messages are targeted. There is an increasingly delayed uptake of social role transitions; it is unclear whether such shifts are related to the patterns of alcohol consumption we observed here. The adoption of policies and interventions, including those to reduce alcohol availability (via shortened trading hours and fewer outlets), increase cost (via taxation) and discourage drinking to intoxication, may assist in reducing binge alcohol use in future cohorts of young people.

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