



alcohol in adolescence - what the research tells us

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Alcohol "is the largest risk factor for health loss and disability among 15-49 year old New Zealanders."¹

Significant changes in brain function make adolescence a time of great opportunity and learning, but also of increased risk.² In this article we look at the current understanding of how alcohol can affect adolescents.

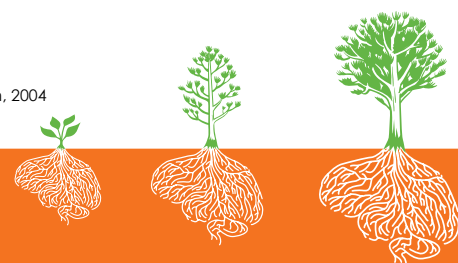
Alcohol is a psychoactive drug that easily becomes addictive³. In New Zealand "binge drinking"⁴ is the most common form of problem substance use, far more so than other psychoactive drug use. Almost 22% of high school students (aged 13 to 18) say they have binged in the last

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month.⁵ Despite this relatively few parents identify alcohol-related issues as a concern, particularly when compared to issues such as drugs and peer pressure.⁶ Parents may need further knowledge about the harms of adolescent drinking.

Adolescence is the period between puberty and full brain maturity (adulthood), now considered to be from age 10 to around 24 years. However, individuals vary greatly with some 10-year olds being nowhere near puberty,⁷ for example. When thinking about a particular adolescent it's useful to consider their individual developmental stage rather than just chronological age. In this article, the term *adolescent* is used interchangeably with *rangatahi*.

1. Cobiac & Wilson 2018, p.1
2. Giedd, 2008
3. NZLC R114, 2010
4. Fleming et al., 2014
5. Fleming et al., 2020
6. BRC Marketing & Social Research, 2004
7. Sawyer et al., 2018



Brain changes during adolescence

As recently as the 1990s, when new technology like MRIs allowed scientists to peek into living brains, they discovered a second period of dramatic changes after early childhood.

Positive experiences set rangatahi up to do well. But, things that interfere with normal brain development, like drugs and alcohol, can have an ever greater negative impact than they do at other times.

How much do New Zealand rangatahi drink?

There is a full continuum of drinking habits among rangatahi from those who have never touched alcohol to those with an Alcohol Use Disorder (AUD).⁸ Many, but by no means all, New Zealand rangatahi drink alcohol. In New Zealand the most common form of problematic substance use is binge drinking.⁹

Patterns of alcohol consumption in New Zealand have been captured since 2000 by the Youth 2000 Survey, a series of regular, large self-report surveys of high school students. Based on the 2019 survey this table shows the percentage of students who reported drinking at least once a week, and those who binge drink (defined as having 5 or more drinks in one 4-hour session). We see the rate of both increases with age.

Alcohol Use among New Zealand Adolescents Youth 2019 Rangatahi Smart Survey ¹⁰			
		What % of students drink alcohol at least once a week?	What % of students binged in the last month?
Total	Students	9.1%	21.8%
Gender	Male	10.2%	22.9%
	Female	8.1%	20.8%
Age	13 and under	2.0%	4.1%
	14	3.4%	7.7%
	15	8.3%	19.4%
	16	11.7%	29.3%
	17 and over	17.7%	42.1%

Binge drinking in 2019 has fallen from a peak of 36% in 2007, which is good news. However, New Zealand's adolescent binge drinking remains high compared with other countries, and continues to cause harm.¹¹ Rangatahi tend to drink less frequently than adults, but drink more when they do drink.¹²

How much is too much?

It is the pattern of alcohol use which is most relevant.

Binge drinking, usually defined as 4 standard drinks (for girls) and 5 (for boys) over a 2-hour period, is the subject of much of the research.

Heavy drinking is binge drinking but with higher frequency (5 or more days in the past 30 days).¹³ Given that 42% of NZ's senior students say they have binged in the last month we should be concerned. According to the research, every binge drinking episode has the potential to be damaging.

If you are drinking more quickly than your liver can process the alcohol, your Blood Alcohol Concentration

(BAC) will rise. Another definition of binge drinking is the amount of alcohol necessary to increase BAC to 0.08%. For comparison, the legal driving limit for those 20 and over is 0.05%, although drivers under 20 must have zero alcohol in their blood. There are lots of individual differences including, bodyweight, whether food has been eaten, lack of sleep, for example, which affect the BAC.



Age of first drinking

Different researchers use different ways of defining what exactly is meant by "starting" to drink alcohol. All of the following get used in the research:

- age of first sip
- age of first full drink
- age first 'got drunk'

This can lead to some confusion, however we do know that:

- Both an early age of first drinking and a quick progression to drinking to intoxication appear to make tamariki more likely to drink while at high school.¹⁴
- Age at first drink was seen as an important determinant when looking at ongoing harms from alcohol.¹⁵
- Given that most short-term harms from alcohol use in adolescence result from intoxication rather than exposure to alcohol,¹⁶ age at first getting drunk is considered by some researchers to be a more robust predictor of **adult** substance use disorder outcomes than age of first drink.¹⁷

Regardless of the specific measure used, there is a high level of agreement in the research that delaying the start of drinking is associated with better outcomes for rangatahi.

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8. Quigley et al., 2019
9. Fleming et al., 2014
10. Fleming et al., 2020
11. Fleming et al., 2020
12. Tapert & Ebersson-Shumate, 2022
13. Jones et al., 2018
14. Morean, Kong et al., 2014
15. Grant & Dawson, 1997
16. Newton-Howes et al., 2019
17. Newton-Howes et al., 2019

Sensitivity to Alcohol

You might think that adolescent drinkers would be more sensitive to the noticeable effects of alcohol - the things that make a person seem 'drunk' or 'tipsy' - than experienced drinkers. However, based largely on rat studies, the situation is more complex.

In fact, it appears that when rangatahi are showing signs of being drunk – such as slurring, passing out, and not being able to walk in a straight line - they are typically much drunker than an adult doing the same things, and will need to be watched carefully.

These insensitivities to some of the **immediately obvious effects** of alcohol may be particularly pronounced during the early stages of adolescence.¹⁸ It makes it harder for rangatahi themselves, and others, to pick up when they are drinking too much.

The same warning signs may not be there. And yet, they are in more danger from the alcohol as we will see in the next section.

In addition rangatahi are less sensitive to the **sedative** effects of alcohol¹⁹ - that is, they can stay awake longer ... potentially drinking more alcohol.

Even though rangatahi are relatively insensitive to these visible effects of alcohol, they tend to be more sensitive than adults to the **rewarding** effects of alcohol such as alcohol making them less shy in social settings.²⁰ So, rangatahi need less alcohol for the pleasurable effects of drinking but more to get the physical warnings of toxicity.

Most important of all is that we now know that they are more vulnerable to the toxic effects of alcohol on the brain than adults are.²¹

"If recreational drugs were tools, alcohol would be a sledgehammer."²²

Harm to Rangatahi from Alcohol:

"If recreational drugs were tools, alcohol would be a sledgehammer."²²

Harm from alcohol can be both immediate (acute) and long term (chronic). The use of alcohol, particularly drinking to the point of getting drunk, can lead to numerous harms not just to the drinker, but also to others.

Immediate harm

Harm to themselves includes:

- traffic accidents
- vulnerability to sexual/indecent assault
- unprotected sex resulting in unplanned pregnancy or sexually transmitted infections
- alcohol poisoning
- blackouts, and
- suicide.

Harm to others can include:

- violence
- vandalism
- sexual assault

- traffic accidents, and
- neglect of responsibilities for example, neglect of tamariki.²³

A frightening statistic is that, in New Zealand, road traffic crashes account for more than half of all fatalities in 15-19 year olds and alcohol impairment is the largest contributor.²⁴ Another sobering statistic is that alcohol is involved in more than a quarter of NZ suicides.²⁵

Long-term harm

Some of the harms from drinking alcohol are acute i.e. they affect the drinker at the time of drinking. However, there can also be long-term effects on the brain, even if the drinking stops.

The impact of alcohol use on brain development is not a uniform process. It seems to selectively affect some circuits and processes, depending on the developmental stage at which the drinking occurs.²⁶

Binge drinking by rangatahi is associated with an overall cognitive deficit as well as specific impairments in decision-making and inhibition.²⁷

Studies have identified potential negative effects of rangatahi drinking and heavy alcohol use on:

- memory
- learning
- visuospatial function (e.g. to judge the distance between two cars when parking)
- executive function (e.g. paying attention, planning, self monitoring, regulating emotions, working memory etc)
- reading ability, and
- impulsivity (e.g. acting without thinking), potentially into adulthood.²⁸



Physical changes in the brain can be seen

Alcohol has been shown to have the potential to damage parts of rangatahi brains in different ways. Some examples are listed below:

1. **Structural** changes affect the circuitry/connections and sometimes the size of structures. Heavy drinking among rangatahi has been shown to be associated with:
 - A change in the normal adolescent patterns of decreasing gray matter and increasing white matter, with widespread disruption of white matter integrity in several brain regions.²⁹ Binge drinking did this also.

18. Varlinskaya & Spear, 2004

19. Monti et al., 2005; Silveri and Spear, 1998

20. Varlinskaya & Spear, 2004

21. Crews et al., 2000; Monti et al., 2005

22. White, 2003, p.186

23. Crossin et al., 2022; Fergusson & Boden, 2011

24. Kypri et al., 2006

25. Crossin et al., 2022

26. Nguyen-Louie et al., 2018

27. Lees et al., 2019, cited by Lees et al., 2020

28. Lees et al., 2020

29. McQueeny et al., 2009

- A decrease in the volume of the hippocampus, a key region for learning new information and emotional memory.³⁰
- Reduction in the prefrontal cortex.³¹

Even moderate drinking by rangatahi is associated with changes in the “emotional network”, with the normal pattern of connection being vulnerable to disruption.³²

2. Heavy drinking may also lead to changes in how the brain **functions**.³³
 - Alcohol use at ages 12 to 14 was associated with lower educational achievement in later years.³⁴
 - A number of studies have demonstrated that attention performance and other activities were worse in those who had abused alcohol,³⁵ even after they had stopped drinking for a while.
 - Heavy alcohol use and withdrawal symptoms (e.g. following a hangover) were associated with worsening verbal memory and learning over time.³⁶
 - Frequent binge drinkers had poorer working memory compared to low alcohol users.³⁷ Working memory is part of executive function and helps us, for example, to remember the beginning of a sentence so we can understand the end of the sentence, or manipulate a few pieces of information in our head to solve a maths problem.
 - Rangatahi who start heavy drinking may require more executive cognitive control to perform at the same level as non-users. i.e. a heavy drinker needs to use more parts of their brain to do the same thing as non or low alcohol drinkers.³⁸ So, the brain of a chronic drinker has to “work harder” to keep things in mind, like remembering a phone number. If heavy drinking continues, by young adulthood the brain may not be able to compensate as effectively, and performance may begin to decline.³⁹



3. Alcohol-related **blackouts** are the inability to remember things, at least in part, following alcohol. They tend to occur when drinking quickly i.e. rapidly increasing blood alcohol concentrations (BAC),⁴⁰ often from “pre-loading”.
 - At BAC levels around the binge drinking level of 0.08%, rangatahi who experience blackouts show larger memory impairments⁴¹ and greater changes in memory-related brain function⁴² than those without histories of blackouts.
 - A history of blackouts shows lasting changes in learning and memory for visual information.⁴³
 - There may be a genetic component to vulnerability to blackouts.⁴⁴
 - Exposure to alcohol in the womb appears to increase the risk of blackout.⁴⁵

Alcohol consumption in adolescence increases the risk of alcohol dependence in early adulthood.⁴⁶

Adolescent drinking and alcohol dependence

Alcohol consumption in adolescence increases the risk of alcohol dependence in early adulthood.⁴⁶

- A US longitudinal study showed that 40% of those who started drinking alcohol before age 15 were diagnosed with Alcohol Use Disorder (AUD) some time in their lives, compared with just 10% who delayed drinking until 21.⁴⁷
- A small US study showed that rangatahi with histories of heavy drinking showed greatly enhanced brain activity while looking at pictures of alcohol compared with non-alcoholic drinks. The responses of those with limited drinking history was similar for both types of drink.⁴⁸ So, the more alcohol they drink, perhaps the more alcohol becomes attractive to them. This may have implications for setting appropriate advertising industry standards.
- New rodent studies demonstrate that adolescent alcohol use may increase reward responsiveness of the dopamine system to alcohol later in life, with long-lasting neural and behavioural effects into adulthood.⁴⁹

Is there a safe amount of alcohol?

Alcohol related brain changes appear to be dose dependent:

- As you would expect, moderate drinkers, for example show more changes than low drinkers but fewer than high drinkers.⁵⁰
- The very large Adolescent Brain Cognitive Development (ABCD) study in the US is seeking to investigate more closely this dose-dependent effect i.e. the continuum from non-drinkers to heavy drinkers. Studies to date have typically looked at binge or heavy drinkers relative to low or non-drinkers. Just as there is no known safe amount of alcohol for pregnant women to drink without harming their baby, there is no known safe amount of alcohol for rangatahi to drink. At present, it appears that the more you drink, particularly in one session, the more damage you may do to your brain.

30. Medina et al., 2007

31. De Bellis et al., 2005

32. Muller-Oehringer et al., 2018

33. Squeglia et al., 2014

34. Lees et al., 2019, cited by Lees et al., 2020

35. Brown et al., 2000

36. Hanson et al., 2011, cited by Lees et al., 2020

37. Jurk et al., 2018, cited by Lees et al., 2020

38. Lees et al., 2020

39. Tapert et al., 2001

40. Ryback, 1970, cited by Hingson et al., 2014

41. Weatherill and Fromme, 2011, cited by Hingson et al., 2014

42. Weatherill et al., 2012, cited by Hingson et al., 2014

43. Lorkiewicz et al., 2022

44. Nelson et al., 2004, cited by Hingson et al., 2014

45. Baer et al., 2003, cited by Hingson et al., 2014

46. McGee et al., 2000, and Meier et al. 2016, cited by Cobiac & Wilson, 2018

47. Grant & Dawson, 1997

48. Tapert, Cheung et al., 2003

49. Lees et al., 2020

50. Pfefferbaum et al., 2018

Advice from New Zealand's Ministry of Health is that "children and young people under 18 years do not drink any alcohol. Those under 15 years of age are at the greatest risk of harm from drinking alcohol and not drinking in this age group is especially important. If 15 to 17 year olds do drink alcohol, they should be supervised, drink infrequently and at levels below and never exceeding the adult daily limits."⁵¹

Mental Health

Adolescence is a particularly vulnerable time for developing mental health disorders.⁵² Of adults who experience mental illness, around 75% began to show signs of their illness before they were 24 years old.⁵³

Those who consume brain-toxic substances (i.e. alcohol and other drugs) in early adolescence are at increased risk of developing major mental health problems in the later adolescent or early adult years.⁵⁴

"Young people with first lifetime episodes of anxiety, depression or psychotic disorders who also consume significant amounts of alcohol are at increased risk of:

- self harm
- attempted suicide
- accidental injury
- persistence or recurrence of their primary mental health problem."⁵⁵

In other words, alcohol use both increases the likelihood of poor mental health, and increases the risk of poor outcomes for those already facing mental health challenges.



Gender differences in the way alcohol can harm the brain

There are large individual differences in the way brain development unfolds.⁵⁶ One of the factors contributing to these differences is gender. On average, the brains of males and females mature at different rates. Females tend to be less driven than males by sensation seeking and typically show better impulse control than males throughout adolescence.⁵⁷ It should not surprise us then that during adolescent brain changes alcohol can adversely affect brain function in a gender specific way:

- Prefrontal cortex volumes in adolescent females with alcohol use disorders were shown to be smaller than their non-drinking peers. But, in males, they were larger than their peers.⁵⁸
- In females, more drinking days in the year were correlated with worsening visuospatial functioning (judging the distances between things).⁵⁹

- In males, more severe hangover symptoms in the preceding year were correlated with worsening sustained attention.⁶⁰
- Females are at greater risk than males for blackouts.⁶¹
- The results from a large international drinking study have suggested that males and females can have different 'reasons' on average for heavy drinking. Sensation seeking and impulsivity in adolescent boys seem to drive drug and alcohol use i.e. positive reinforcement. However, in girls, stressful experiences and internalizing disorders may drive substance use i.e. negative reinforcement.⁶² This should have an impact on prevention messaging.

Who is most likely to begin drinking early?

Factors which can contribute to alcohol use in rangatahi include:

- family history
- Adverse Childhood Experiences (ACEs)
- sleep disruption, and
- other substance abuse.⁶³

Having even one family member with Alcohol Use Disorder (AUD) is associated with almost double the risk of initiating drinking in early adolescence.⁶⁴

Neurobiological changes associated with severe childhood trauma was significantly related to executive dysfunction and likelihood of high risk drinking in adolescence.⁶⁵ This has implications for care, where childhood trauma is known.

Who is most vulnerable to the harmful effects of adolescent drinking?

It is important to note that the changes in the adolescent brain build on what happened in the early years and that this can affect the child's response to the challenges of adolescence, including alcohol use.

Every rangatahi has a unique set of risk factors (which increase the likelihood of poor outcomes) and protective factors (which increase the likelihood of good outcomes). These result from a complex interplay between genes and experience.

Further risk and protective factors exist throughout our society - from the community to the local and national political level. Examples of these risks might include the density of alcohol outlets, or pricing to attract young drinkers. Protective factors would be the reverse.

New research shows that some environmental factors that occur during the early years may put an adolescent at higher risk. While even low/moderate alcohol use is associated with brain deviations, some factors may increase the risk that children will start drinking early and be more likely to develop problematic alcohol use.⁶⁶

51. Ministry of Health, 2022

52. Agostini & Centofanti, 2021

53. Kessler et al., 2007, cited by Andrews et al., 2020

54. Hickie et al., 2009

55. Hickie et al., 2009, p.3

56. Galvan, 2021

57. Shulman et al., 2015

58. Caldwell et al., 2005

59. Squeglia et al., 2011

60. Squeglia et al., 2011

61. White et al., 2002, Mundt and Zakletskaia, 2012, and, Barnett et al., 2014, cited by

Hingson et al., 2016

62. Kuntsche et al., 2015

63. Tapert & Ebersone-Shumate, 2022

64. Grant and Dawson, 1997, cited by Tapert & Ebersone-Shumate, 2022

65. Silveira et al., 2020

66. Newton-Howes & Boden, 2016

One example is the work of Meier et al⁶⁷ who identified risk factors that increased the likelihood of persistent substance dependence **in adulthood**. These were:

- low family socioeconomic status
- family history of substance dependence
- childhood conduct disorder
- childhood depression
- early exposure to substances
- frequent substance use in adolescence (alcohol, tobacco and/or cannabis), and
- being male.

If we know that adolescents either genetically, or because of their circumstances, have an increased risk for early drinking, this provides an incentive to ensure appropriate care.



The role of parents and whānau

In New Zealand 60% of drinkers aged 13 to 18 say that their parents were their main providers of alcohol.⁶⁸

A large study in the US and Australia⁶⁹ explored parental attitudes towards alcohol, how much parents use alcohol themselves and how much they supervise their adolescent's drinking. Adult-supervised alcohol use resulted in higher levels of harmful alcohol consequences than where adults discouraged the use of alcohol altogether.

Australian teens whose parents permitted them to drink at home were significantly more likely to have ever experienced alcohol-related harm compared to those not allowed to drink at home.⁷⁰ This indicates that, contrary to popular belief, parental permission to drink increases a child's likelihood of alcohol use and risk-taking behaviours.

The role of the state

Unlike some countries, there is no legal restriction on young people drinking alcohol. New Zealand law controls the age of purchase, but not the age of drinking. It has been legal to purchase alcohol at 18 since the age limit was reduced from 20 in December 1999 (some 10 years after all US states which had previously lowered the drinking age to 18, returned to a legal minimum of 21).

Contrary to popular belief, parental permission to drink increases a child's likelihood of alcohol use and risk-taking behaviours.

In its submission to the Law Commission on Alcohol Reform (2010), the New Zealand Police described the knock-on effect of lowering the purchase age:

"... whereas before the law change, the effective drinking age was around 17–19 years of age, the de facto drinking age is now around 14–17 or even younger. Some districts are reporting that 11 and 12 year olds are now impacted upon by alcohol."⁷¹

Their comments were backed up by a study which concluded "from the perspective of protecting youth, the natural experiment posed by the MPA (minimum purchasing age) -reduction appears to have failed, presenting more drinking and more problems among 16–19-year-olds."⁷²

In 2012, with the introduction of the Sale and Supply of Alcohol Act 2012,⁷³ for the first time it became illegal (with a fine of up to \$2000) for people under 18 to be provided alcohol without the express consent (by conversation, email, text for example) of the young person's parent or guardian.

Conclusion

The evidence continues to accumulate that alcohol negatively affects the developing brains of rangatahi, and affects them differently from adults. Alcohol exposure during adolescence has an impact on brain structure and function in the short term, but it may also lead to consequences for various brain functions that last into adulthood.⁷⁴

It appears to be the pattern of drinking known as binge drinking (4 or 5 standard drinks in a session) that is most likely to cause brain damage. However, there is no known 'safe' amount of alcohol for rangatahi.

Many rangatahi are drinking regularly and drinking heavily. What can be done? There are, regrettably, no silver bullets. But there are a number of evidence-based policy interventions⁷⁵ which could be effective in reducing alcohol-related harm.

Delaying the onset of alcohol use until well after early adolescence may reduce the risk for harm of alcohol use on the brain.⁷⁶ In addition, efforts designed to delay intoxication may help lessen alcohol-related risk associated with early drinking.⁷⁷

Where rangatahi are known to have a number of risk factors which might predispose them to early alcohol use, it is even more important that the use of alcohol is delayed.

Alcohol hasn't just started affecting the brains of rangatahi – it has done so through history – but we can't keep ignoring the potential harm. Isaac Asimov, the biochemist and science fiction writer, understood this well when he said "the saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom."⁷⁸

67. Meier et al., 2016

68. Adolescent Health Research Group, 2013

69. McMarris et al., 2011

70. Quin, 2021

71. NZLCR 114 (Law Commission), p.261

72. Gruenewald et al., 2015, p.8

73. Sale and Supply of Alcohol Act, 2012

74. Hiller-Sturmhofel & Swartzwelder, 2004

75. NZLR 114, 2010

76. Nguyen-Louie et al., 2018

77. Morean, Kong et al., 2014

78. Asimov 1988, p.281

Glossary of Māori terms:

Rangatahi – youth, younger generation

Tamariki – children

Whānau – extended family

Useful Links

Health Promotion Agency Resource: [Click here](#)

Blood Alcohol Concentration estimate: [Click here](#)

If you enjoyed this article, the following articles may be useful:

Why sleep matters for rangatahi: [Click here](#)

Adverse Childhood Experiences: Understanding their effects: [Click here](#)

Short term highs, long term risks?: [Click here](#)



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How do we measure alcohol?

The concept of a “standard drink” is a measure of the amount of pure alcohol (10 grams = 1 standard drink) being drunk, regardless of what type of drink e.g. wine, beer, cider, alcopop/RTD etc.

This is the one reliable measure for knowing how much alcohol is being consumed. By New Zealand law, all bottles and cans of alcohol state how many standard drinks are included. There can be vast differences between seemingly similar looking products e.g. RTDs (which look like soft drinks) generally range from 4% to 7% alcohol. A 330ml can of 4% is 1.2 standard drinks and 7% is 1.8. This means that say 3.3 cans of 4% or just 2.2 cans of 7% would be deemed binge drinking for a female if drunk in one session. Parents may find The Health Promotion Agency's graphic (link at the end) useful to see this in practice.

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