

Prevention of alcohol-related harms

*Prevention research
evaluation report*

*Prevention research
summaries*

Reading and resource list

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The research presented in this publication represents work done on behalf of the DrugInfo Clearinghouse by the two collaborative teams of the Centre for Youth Drug Studies at the Australian Drug Foundation and the Centre for Adolescent Health at The University of Melbourne.

DrugInfo Clearinghouse is an initiative of the Australian Drug Foundation and the Victorian Premier's Drug Prevention Council.

The harms and consequences of alcohol use in adolescence

Summaries prepared by Associate Professor John W Toumbourou,
Centre for Adolescent Health

The summaries that follow provide a sample of some of the literature relevant to the harms and consequences of alcohol use in adolescence. The first three summaries present literature reviews that examine evidence from developmental neuropsychiatry, neuropsychology and physiology. Papers presenting empirical studies follow these. The empirical studies include epidemiological and follow-up research with young people and an example of the experimental studies being conducted (including one with adolescent rats). The topics investigated include adolescent vulnerability to alcohol use, the damage to behavioural development due to alcohol use in childhood and adolescence and follow-up studies investigating the proposition that adolescent alcohol use is a contributory cause in suicidal behaviour.

Adolescent vulnerability to alcohol use

Chambers RA, Taylor JR & Potenza MN 2003

"Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability", *American Journal of Psychiatry*, 160, pp. 1041–52

Key findings This paper presents an interpretive overview of both animal and human anatomical, physiological and pharmacological research on the neural networking of the brain systems that functionally underlie motivated and addictive behaviour.

The specific focus is on brain changes through adolescence. The authors argue that during adolescence brain development can be observed in areas such as the frontal cortex and within midbrain regions which clinical research have associated with motivation, impulse control and addiction. These developmental changes to the adolescent brain are interpreted to explain a lowering of impulse control and heightened adventurousness through this period, operating to confer an increased vulnerability to addiction.

Study quality was moderate This study should be evaluated against its objective of synthesising and integrating a range of information to achieve theory development in neuropsychiatry. An impressive range of recent neuroscience was interpreted in language that was, for the most part, accessible. Inclusion criteria were not clarified and the paper presented little critical appraisal of the studies presented.

Brown SA & Tapert SF 2004 "Adolescence and the trajectory of alcohol use: Basic to clinical studies", *Annals of the New York Academy of Sciences*, 1021, pp. 234–44.

Key findings A selection of recent neuro-psychological research relevant to the impact and consequences of adolescent alcohol use is presented. Evidence from a number of experimental studies with rats demonstrates that exposure to binge drinking results in more brain damage and cognitive functional impairment when it occurs in adolescence rather than in adulthood. Studies with humans are also linking adolescent alcohol use with structural brain damage and functional loss, with some deficits more pronounced for girls.

A longitudinal follow-up study with adolescents associated poorer visuospatial functioning with

The harms and consequences of alcohol use in adolescence

excessive alcohol use and the experience of withdrawal. Brain imaging studies have identified physical abnormalities in the nerve tissue connecting the left and right cortex in adolescents with lifetime episodes of heavy alcohol use. One functional imaging study found that, in the early stages of an alcohol use disorder, adolescents used an atypical part of the brain to perform a spatial memory task. This finding was interpreted as evidence of adolescent brain damage due to alcohol use being potentially masked due to brain compensation protecting functional performance. However, when heavy drinking and neural injury continued, the brain capacity to compensate appeared to diminish, resulting in observable impairments to function.

Study quality was low to moderate Findings were integrated in accessible language across a range of methodologies, including experimental studies with rats and human studies using cognitive testing and neuro-imaging technologies. The review was deliberately selective, presenting an overview biased toward recent work, largely completed by this team which is explicitly aiming to identify problems associated with adolescent alcohol use.

White AM & Swartzwelder HS 2004 "Hippocampal function during adolescence: A unique target of ethanol effects," *Annals of the New York Academy of Sciences*, 1021, pp. 206–20.

Key findings The hippocampus is a mid-brain structure which plays an important role in the formation of new memories. This paper reviews laboratory simulation-studies performed with sections of the rat hippocampus and human spatial memory experiments that examine the effect of adolescent alcohol use on the hippocampus.

Simulation studies have localised an important mechanism underlying the impact of alcohol on the hippocampus, involving interference with a glutamin receptor chemical. There is evidence that both functional memory and simulated hippocampal function are adversely impacted by alcohol use, with effects dose-related and measurable after only one or two alcoholic drinks. These specific spatial memory and functional simulation effects are more evident in the adolescent phase than in adulthood, with this effect still evident into the early twenties. For

example, spatial memory recall was more impaired under a small dose of alcohol when subjects were in their early twenties, compared to subjects in their late twenties. While the adolescent brain is more sensitive than the adult brain to hippocampal-related memory deficits following alcohol use, animal experiments demonstrate that adolescents are also less sensitive compared to adults to the sedative and motor-impairing effects of alcohol.

Taken together, the implication of these findings are that adolescents may be capable of drinking large amounts of alcohol while also being more sensitive to the dose-related hippocampal memory impairment associated with alcohol use. Alcohol use in adolescence also appears to change the brain so that it continues to be less sensitive to motor impairment following alcohol use into adulthood. Although there are functional changes, studies are yet to clarify whether adolescent "binge drinking" causes observable, long-term brain damage.

Study quality was low to moderate This reader was left in awe at the detailed knowledge that has accumulated over the past two decades relevant to the effect of alcohol on the structure and functioning of the hippocampus. Findings were integrated in accessible language across a range of methodologies including laboratory simulation studies and human memory studies. The paper was an expert overview and hence lacked some of the qualities sought from a systematic review.

Adolescence as a vulnerable period for alcohol use

Brown SA, Tapert SF, Granholm E & Delis DC 2000 "Neurocognitive functioning of adolescents: Effects of protracted alcohol use", *Alcoholism: Clinical and Experimental Research*, 24:2, pp. 164–71

Key findings Alcohol-dependent adolescents (N=33) with over 100 lifetime alcohol episodes and without dependence on other substances were recruited from alcohol/drug abuse treatment facilities. This sample was compared with a comparison group of 24 adolescents who had no history of alcohol or drug problems but otherwise matched demographically and with respect to family history of alcohol dependence.

Cognitive testing revealed that the alcohol-dependent adolescents showed poorer performance on verbal and non-verbal learning tasks. Recent alcohol withdrawal was associated with poorer visuospatial functioning, whereas lifetime alcohol withdrawal was associated with poorer retrieval of verbal and non-verbal information.

Study quality was low Findings of a functional difference were based on a small sample and a cross-sectional and correlational design. The design cannot rule out the possibility that the functional deficits evident in the alcohol-dependent sample preceded their alcohol use.

Varlinskaya EI & Spear LP 2004 "Changes in sensitivity to ethanol-induced social facilitation and social inhibition from early to late adolescence", *Annals of the New York Academy of Sciences*, 1021, pp. 459–61

Key findings In this study the social activity of rats was observed at different age periods during adolescence and under different levels of exposure to alcohol use. The effect of alcohol on social behaviour was found to be more marked for rats during the early adolescent phase, relative to middle and late adolescence, with effects evident both for higher levels of social facilitation at low doses of alcohol and reduced social inhibition after a moderate alcohol dose. Their differential experience of benefits and impairment suggest that early adolescents may be more vulnerable to social cues, leading to excessive alcohol use.

Study quality was moderate Findings were derived using an experimental paradigm, albeit from a single study. It remains unclear whether these findings will generalise to human behaviour.

Patton GC, McMorris BJ, Toumbourou JW, Hemphill SA, Donath S & Catalano RF 2004 "Puberty and the onset of substance use and abuse", *Pediatrics*, 114:3, pp. e300–306

Key findings A survey involving close to 6000 students from Washington State in the United States and Victoria, Australia investigated markers of puberty, substance use and risk factors for substance use. Stages of puberty were found to be better predictors of levels of substance use (tobacco,

alcohol or illicit drug use) than age or school year level. Potential risk processes mediating the relationship between puberty and substance use were investigated.

Findings supported the view that puberty acted to increase the risk of substance use due to its influence in increasing the tendency to peer affiliation. As the social context currently involves a high level of peer drug use, in late puberty more friends were reported to be substance users, and this partly explained the effect of puberty on substance use. The implication of the study is to support the view that adolescence is a heightened period of vulnerability to peer risk factors for substance use.

Study quality was low to moderate Findings were based on a cross-sectional survey and hence should be confirmed in a longitudinal design.

Early age alcohol use and more regular use of alcohol in adolescence predicts the development of harmful alcohol use

Fergusson DM, Horwood LJ & Lynskey MT 1995 "The prevalence and risk factors associated with abusive or hazardous alcohol consumption in 16-year-olds", *Addiction*, 90:7, pp. 935–46

Key findings Using data from the Christchurch, New Zealand longitudinal birth cohort study (N=953), risk factors for heavy and harmful alcohol use at age 16 were explored. At age 16, responses were obtained to a range of questions relevant to alcohol use. On an empirical basis a group was identified with high levels of harmful alcohol use at age 16.

Analyses were directed towards identifying pathways to the age-16 harmful alcohol use. In multivariate analyses, predictors included male gender, affiliation with substance-using peers at age 15 and the amount of alcohol consumed at age 15. Age-15 alcohol use was itself predicted by age-14 alcohol use and by family factors. Age-14 alcohol use was in turn predicted by family factors, conduct problems and the age at which the child had been initially introduced to alcohol.

Study quality was high The study suffered from little attrition in a large and representative sample. Analytic methods attempted to model carefully the underlying characteristics of the data.

Toumbourou JW, Williams IR, White VM, Snow PC, Munro GD & Schofield PE 2004

“Prediction of alcohol-related harm from controlled drinking strategies and alcohol consumption trajectories”, *Addiction*, 99:4, pp. 498–508

Key findings In another study conducted in Victoria, final-year high school students (N=1596) were surveyed then followed-up and resurveyed three times during the period following high school and again when they were 21. The study found that the level of drinking in high school predicted trajectories of drinking in the post-school period. These trajectories in turn predicted drinking levels and harms at age 21. Over one-quarter of males and females drank alcohol, but on a less-than-weekly basis. This pattern of alcohol use demonstrated considerable stability through the post-school transition and was associated with a low level of subsequent harm at age 21.

The authors concluded that future research should investigate whether encouraging more Australian adolescents to drink alcohol on a less-than-weekly basis may be a practical intervention target for reducing alcohol-related harms.

Study quality was moderate Findings were based on a multi-wave longitudinal design and a large sample. However, the study suffered from differential loss of heavier drinkers. Although efforts were made to adjust for this bias, future research in more representative samples should attempt to confirm these findings.

Does adolescent alcohol use increase the risk of suicidal behaviour?

Windle M 2004 “Suicidal behaviors and alcohol use among adolescents: A developmental psychopathology perspective”, *Alcoholism, Clinical and Experimental Research*, 28:5 Supplement, pp. 29S–37S

Key findings Previous research has associated adolescent alcohol use with suicidal thoughts and behaviours. In this paper a conceptual model was developed and then tested relevant to the processes linking adolescent alcohol use with suicidal behaviour

In this model, biology and temperament, childhood family and other socialisation factors were considered

to elevate the risk for stress, mental health and health behaviour problems in adolescence, including excessive alcohol use. These problems were in turn considered to elevate the risk of suicidal behaviours. The model was tested in a sample of around 1200 United States high-school students who were followed for two years. Path analytic models revealed that depression predicted subsequent suicidal thoughts, intentions and attempts. Stress predicted suicidal thoughts and attempts. After controlling for these influences, “binge drinking” predicted suicide attempts.

Study quality was moderate The study was evaluated against criteria for a theoretical review. A range of previous research was interpreted and synthesised into a testable theory which linked alcohol use and suicidal behaviour.

The review lacked inclusion criteria and an explicit, critical appraisal of available studies. However, the effort of developing and then testing theory in a single paper was commendable. The theory linked the key variables but may lack some specificity with respect to the larger body of existing social behavioural theory. The longitudinal study had a reasonable initial response rate (76 per cent) and excellent retention (above 90 per cent).

Light JM, Grube JW, Madden PA & Gover J 2003 “Adolescent alcohol use and suicidal ideation: A nonrecursive model”, *Addictive Behaviors*, 28:4, pp. 705–24

Key findings A survey was completed by 600 United States students (aged 12 years and older) and then repeated two years later. At both study waves the experience of common alcohol-related problems (for example, feeling sick, hangovers, school problems) were associated with suicidal thoughts and behaviours. The study investigated the direction of the relationship between suicidal thoughts and behaviours and alcohol-related problems, and found different models applied for males versus females. Although alcohol-related problems predicted suicidal thoughts and behaviours for males, for females suicidal thoughts and behaviours led to an increase in alcohol-related problems.

Study quality was moderate The study design had the advantages of a longitudinal follow-up and

confidential face-to-face interview techniques, and the analytic model appeared to fit the data well. The initial response rate was reasonable (72 per cent) as was the follow-up retention (85 per cent). Data analyses were carefully conducted and directed at identifying a good fit to the data.

However, one problem with the design was that it incorporated only two waves of follow-up, and it may

require additional follow-up to resolve the complex reciprocal effects being investigated. In addition, the sample size was relatively small once analyses were broken down by gender. The heterogeneous age range of the sample may have also masked different processes that could be expected to operate early versus later in adolescence.

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DrugInfo Clearinghouse
409 King Street West Melbourne
Victoria 3003
Email: druginfo@adf.org.au