Alcohol and the teenage brain: Safest to keep them apart

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Recently College President Lauchlan McIntosh met with DrinkWise Australia to discuss areas of mutual interest and a potential partnership. DrinkWise is a not-for-profit research and social change agency that is dedicated to building a culture in Australia where intoxication or 'drinking to get drunk' is considered unacceptable. As road safety authorities are well aware, the individual and social harms associated with this culture are significant and borne by everyone in the community.

The President was made aware of research commissioned by DrinkWise, which summarizes the current literature in relation to alcohol and the teenage brain. The paper [1], a summary of which appears below, provides strong support for actions by licensing authorities to separate novice drivers from drinking and driving.

DrinkWise advises parents that delaying drinking for as long as possible is still the best message for teenagers. Research is clear that the younger the age children are introduced to alcohol, the more likely they are to develop a range of problems, including dependence later in life. The DrinkWise website at www.drinkwise.com.au provides practical advice for parents in dealing with the issue.

The full article, along with related research about alcohol consumption, cultural drivers and community attitude, can also be found on the DrinkWise website.

What do we know about alcohol and the teenage brain?

Traditionally, the major components of brain development were believed to occur before birth and in early childhood. Consequently, there has always been a strong view that exposure to alcohol and other substances that are toxic to brain cells should be minimized during these periods. The most recent National Health and Medical Research Council guidelines (2009) [2] have significantly reinforced this perspective.

Most cultures have recognized that, with the onset of puberty, individuals move rapidly towards sexual maturity and associated adult responsibilities. Consistent with that major change in social roles, and its associated rites of passage, consumption of alcohol and other substances is encouraged or at least widely tolerated.

Following the discovery of new highly sensitive brain imaging techniques in the 1990s, as well as key findings about the ways in which nerve cell connections are radically reshaped in the post-pubertal period, these traditional views are now undergoing significant re-evaluation. At this time, it is rapidly becoming clearer that alcohol and the teenage brain don't mix and that exposure to alcohol should be postponed and preferably avoided at least until the late adolescent or early adult years.

Much of the clinical, neuroimaging and neuropsychological literature demonstrating the adverse effects of alcohol on the brain is based on adult rather than teenage subjects. The inferences concerning the likely toxic effects of alcohol on the adolescent brain also rely strongly on findings in developing animals rather direct observations in human studies. Those animal studies have tended to emphasize the long-term adverse cognitive and behavioural effects of alcohol and other drug exposures during the relevant 'adolescent' periods of brain development.

Traditionally, the more conservative academic position has highlighted the lack of a large number of long-term human studies and, hence, concluded that the potential adverse effects of early exposure to alcohol amongst teenagers and young adults should not be overstated. While this perspective is understandable, it needs to be balanced first by the emerging findings in human neuropsychological and neuroimaging studies. On balance, the available studies suggest that the adolescent brain is particularly sensitive to the negative effects of excessive or prolonged alcohol exposure, including the adverse effects of binge drinking.

Additionally, one needs to consider the large body of evidence of the degree of direct harm due to injury (including significant head injuries) that results from excessive risk-taking in young people who consume alcohol. This degree of risk-taking while intoxicated is likely to reflect the combination of the disinhibitory effects of alcohol (which are present at all ages due to dampening down of frontal lobe function) and the relative lack of development of the frontal lobes in adolescents. From this perspective, the risk of accidental injury due to excessive risk-taking and poor impulse control is particularly likely to be evident in younger teenagers who use alcohol.

If one weighs up the available evidence concerning direct risks to brain development, short- and long-term effects on cognitive and emotional development, and risks of associated injury due to poor judgment and lack of inhibition, on balance, two conclusions now appear to be justified:

- Alcohol should not be consumed by teenagers under the age of 18 years
- Alcohol use is best postponed for as long as possible in the late teenage and early adult years.

What is the scientific support for this view?

The key emerging scientific issues that support this view are as follows:

1. The frontal lobes of the brain underpin those major adult functions related to complex thought and decision, and inhibition of more child-like or impulsive behaviours. These parts of the brain undergo their final critical phase of development throughout adolescence and the early adult period. While there is considerable individual variation in this

process, it appears to continue well into the third decade of life (age 22-25 years) and may be particularly prolonged in young men.

2. Key parts of the temporal lobe, including the amygdala and hippocampus, continue to undergo development during the adolescent period. The amygdala underpins the normal fear response, while the hippocampus is an essential part of normal memory function.
3. The final phase of frontal lobe development occurs at the same time as the onset of all of the common and serious mental health problems. Seventy-five per cent of adult-type anxiety, depressive, psychotic and substance abuse related disorders commence before the age of 25 years.
4. Alcohol has significant toxic effects on the cells of the central nervous system, and depending on dose and duration of exposure, is likely to result in serious short-term and long-term harm. Those harmful effects are most likely to be evident in areas in which the brain is still undergoing rapid development (i.e., frontal and temporal lobe structures).
5. Alcohol, even in small doses, is associated with reduction in activity of the normal inhibitory brain processes. Given that such processes are less developed in teenagers and young adults, alcohol use is likely to be associated with greater levels of risk-taking behaviour than that seen in adults.
6. Alcohol normally results in sedative effects as the level of consumption rises. It appears that teenagers and young adults are less sensitive to these sedating effects (due to higher levels of arousal) and are, therefore, likely to continue with risk-taking behaviours. As they also experience loss of control of fine motor skills, the chances of sustaining serious injuries (including head injuries) are increased.
7. Exposure to significant levels of alcohol during the early and mid-adolescent period appears to be associated with increased rates of alcohol-related problems as an adult, as well as a higher rate of common mental health problems such as anxiety and depression.
8. 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 and accidental injury, as well as persistence or recurrence of their primary mental health problem.

References

1. Hickie, I.B., Whitwell B.G. Alcohol and the teenage brain: Safest to keep them apart, BMRI Monograph 2009-2, Sydney: Brain & Mind Research Institute, 2009.
2. National Health and Medical Research Council. Australian guidelines to reduce health risks from drinking alcohol. NHMRC, 2009.

Road Safety Literature

AP-T149/10: Road safety engineering risk assessment - Part 4: treatment life for road safety measures

This Austroads report considers the length of time a road safety treatment is expected to remain in place and be of a sufficient standard to continue providing a safety benefit.

Download at www.onlinepublications.austroads.com.au/Script/Details.asp?override=1&SAID=9000&UpdID=494&SID=306447&DocN=AUSTROADS31248.

AP-T157/10: Reviewing ITS technologies and road safety opportunities

This review estimates the potential crash avoidance and injury reduction benefits of different types of Intelligent Transport Systems (ITS) technologies for Australia and New Zealand. Download at www.onlinepublications.austroads.com.au/Script/Details.asp?override=1&SAID=9000&UpdID=494&SID=306447&DocN=AUSTROADS05613.

CASR066 - Vehicle speeds in South Australia 2008

CN Kloeden and JE Woolley assess the effects of speed reduction countermeasures in South Australia. All but one road type showed reductions in speed measurements from 2007 to 2008.

Download at casr.adelaide.edu.au/publications/list/?id=1162.

The effects of Electronic Stability Control interventions on rural road crashes in Australia: Simulation of real world crashes

About 60 per cent of all fatal road crashes in Australia occur on rural roads. Electronic Stability Control (ESC) is an active safety system that has shown potential in preventing crashes on high speed rural roads. The ESC system can detect when a vehicle is about to skid and apply braking interventions to individual wheels to prevent the skid from occurring. Previous studies have shown that vehicles equipped with ESC have a significantly reduced crash rate compared with vehicles not equipped with ESC.

However, the way that the ESC system intervenes to prevent or lower the severity of crashes on rural roads has not been elucidated. Twenty crash scenarios were developed based on actual rural road crashes obtained from an in-depth crash database. With the assistance of Robert Bosch (Australia) Pty. Ltd., 12 of the scenarios were simulated using a vehicle model with and without ESC fitted.

The simulations produced detailed plots that displayed the timing and magnitude of the ESC systems interventions. For the 12 successful simulations, ESC was found to prevent a collision in 10 cases and reduce the severity of a collision in the other two.

Download at http://www.infrastructure.gov.au/roads/safety/publications/2009/RSRG_2009005.aspx.

(*Reviewed by Colin Grigg*)