Alcohol and Adolescent Brain Development

Is alcohol use more dangerous for adolescents than for adults? It has been suggested that one good reason for postponing alcohol use is the potential effect on brain development. In a recent article, Clark, Thatcher and Tapert (2008) examined this question and concluded that the evidence is not yet complete.

The brain continues to develop during most of life (or we would never learn anything new); however, development and reorganization during adolescence is quite active. The regions that are of particular interest from puberty through young adulthood are the **prefrontal cortex**, regions of the **limbic system, white matter** (or **myelin**) and the **reward circuits,** including the **amygdala** and the **nucleus accumbens**. The **prefrontal** regions are concerned with what are often called "executive functions:" judgment, planning and impulse control. This part of the brain begins its development early in life but is not fully mature until the early twenties. The **limbic system** is concerned with new learning (in the **hippocampus**) and with response to emotionally important information (in the **amygdala**). **White matter** or **myelin** development is associated with increased efficiency in the transmission of information in the brain. Loss of white matter due to various diseases, including alcoholism, leads to slower processing of information as well as, in some cases, disability. The so-called "**reward systems**" in the brain are really networks that link the prefrontal areas, the amygdala and certain subcortical areas including the **nucleus accumbens**, which is associated with anticipation of rewards and has been linked to various addictions. The concern about alcohol is that this drug will interfere with the orderly development of these systems.

Using new brain imaging techniques, like MRI, it has been demonstrated that, in adults who abuse alcohol and other drugs, deficits can be observed in many of these brain areas. For instance, the hippocampus, which is necessary for new learning, is smaller in alcoholics. It is also smaller in people who have experienced extreme stress. It is believed that during adolescence the hippocampus may be particularly sensitive to negative effects of alcohol and some studies have found that adolescents who are diagnosed with alcohol use disorders (AUD) have smaller hippocampal volumes. The authors caution, however, that there are only a few studies as yet and it is possible that the young people who abused alcohol had smaller volume to begin with either because of heredity or because of the stress in their lives.

However, more support for the theory that alcohol may affect the brain negatively at this age was found when another region, the amygdala was examined. This regulator of emotional response was also found to be smaller in alcohol-using adolescents as well as in alcoholic adults. Similarly, studies that look at white matter find that it is more disorganized in certain brain areas as a result of exposure to alcohol.

During adolescence, much new learning is taking place. As young people grow physically and experience puberty, they have to reorganize much of their thinking and behavior to deal with the changing demands of their lives. The changes in the brain accompany and support these other changes. Adolescents who abuse alcohol may affect the way in which complex brain systems come to interact both through the experiences they have in life and through physical effects on their brain. Although research in this area is just beginning, eventually a better understanding of how these factors interact may allow prevention of negative consequences and intervention for alcohol abuse.

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References

Clark, DB, Thatcher, DL & Tapert, SF (2008) Alcohol, Psychological Dysregulation, and Adolescent Brain Development. Alcoholism: Clinical and Experimental Research, 32,(3), 375-385