

A review of literature on the cognitive development of adolescents with substance misuse

The term cognitive development demonstrates the part of our brain that is the key to knowledge, new skills and problem solving and helps younger children and adolescents understand the world (Byrnes, J. P. 2006). Adolescence is the stage of transitioning from a child into an adult and ranges from ages 10-24 and is a stage in life that is the most impactful for the future in life. The literature has suggested that adolescents experience rapid cognitive growth within this stage. During this time it can be highly confusing because of these rapid changes occurring (Sebre & Miltuze, 2021) as well as being an emotional time (Michikyan & Suarez-Orozco, 2016). Affecting how we think and one's decision making (World Health Organization: WHO. 2019, November 26). The key element stated amongst this literature of cognitive development will be the influence of substance misuse (SM). Researchers much like Swadi (2000) consider that substance misuse is on the increase, finding that adolescents aged between 12 and 17 in mental health services had the likelihood of drug use of 13% overall (16.3% among boys and 9.3% with girls). Despite this high prevalence, there are not many organised treatments for adolescents in the UK, instead a heavier view on prevention. According to Gould TJ (2010), The places in the brain that come under the neural connectives between addiction cover each other largely, supporting cognitive functions, such as learning, memory and reasoning. If there is a high activity of drug usage in these areas during early development, an individual may develop maladaptive connections with drug usage and environmental elements that could connect seeking behaviours. As adolescence is the most important years of a person's life, anything that happens within those years can be highly influential later. In which case this literature review will evaluate critically the research placed which addresses the impact of SM and encourage any areas that could be explored further or added to.

The literature that has aimed at this key stage of development with adolescents who have dealt with substance misuse showcases that it is a challenge proposed to many (Squeglia LM et al., 2009). Lubman, D. I., et al (2007) showcased that early misuse of substances has related to an increase in risk for a diverse amount of outcomes later in life, with literature on early usage suggesting that those during adolescence could be exposed more harshly to addictive substances as the various neuromaturation processes that are happening during this stage. These are suggestions of disruptions through development within early years users. Those of an earlier use of drugs report heightened numbers of health issues, most prominent with symptoms of anxiousness and depression, as well as any behavioural disorders which are known to be key elements that influence individuals who are regular users (Mills KL *et al.*, 2005), as well as being connected to several childhood difficult events, which could include earlier psychological problems, family issues or struggles with school and behavioural difficulties (Macleod *et al.*, 2004). Expanding amounts of animal studies showcase the use of substances while in adolescence aggravates the functioning of neuroendocrine which can lead to higher issues on neural plasticity and cognition in adults. There is also evidence that drug exposure during this time can heighten sensitivity to drugs later on as well as diminishing adult cognitive functioning and even promote to cortical damage. There has been little testing on human adolescent brains as they are hard to conduct, although there is still evidence from slight human testing of the effects (Rutherford HJ et al., 2010). Several studies have showcased smaller hippocampal volume with adolescent individuals diagnosed with alcohol use disorders (AUD) compared to healthy participants (Clark, D. B et al., 2017). One study demonstrating that volumes within the hippocampus were correlated well with age of use for the first time and badly with longer time of use. Those with AUD have been reported to have smaller pre-frontal cortices with more white matter, with a large correlation noticed between prefrontal cortical and measures of the amount of alcohol consumed (De Bellis *et al.*, 2000). There have also been structural abnormalities with alcohol related cognitive impairments amongst adolescents that are heavy consumers (Tapert and Brown., 2004).

To prevent the failure of adolescents involvement with alcohol and drug use, public investment is needed and early school interventions. In doing so this will decrease negative occurrences with adolescence drug use (Toumbourou and Catalano et al., 2005). Furthermore, the literature has also shown that heavy drinking during the time of adolescence does have a small however significant effects on adolescent neuro-cognitive functioning. Resulting with memory issues as well as problems with attention and processing information. Another study conducted by Brown, S. A & Tapert, S. F. (2004), comparing alcohol dependent with healthy control adolescents, resulting in findings were that frequent consumers rephrased 10% less verbal and non verbal compared to those participants that were controlled once being monitored for three weeks. A result which was similar of poorer result was founded on attention and information processing tasks in adolescent drinkers. Literature examining neurocognitive deficits were consistent in their findings in young individuals that drink heavily, in which showcased several alike downfalls within attention and processing, falling alongside deficits in language and academic performance. Recent data conducted in literature by Volkow ND (2014) examining health effects of using marijuana, showcased that those who are heavy smokers performed lower on tests of learning, cognitive flexibility, conducting data and visualising errors and damages to their working memory after four weeks of monitored abstinence, concluding that the use of this substance related heavily to overall poorer functioning excluding the fact if there was alcohol use also. To conclude, those who have a higher prevalence of alcohol perform lower in cognitive abilities compared to those that don't drink as well as the tests done with the use of marijuana in which also performed poorer, these results showcase that substance use has a significant effect on the way the brain works and affects a number of areas. Moreover, a study by O'Leary-Barrett M et al., (2017) examined the impact of adolescent substance abuse on cognitive development and addiction, through a personality aimed intervention programme. This study also proved that substance use and drinking extensively through adolescence was linked with neurocognitive abnormalities, issues with mental health and risk at future addiction. Also stating that substance use during this time is a guarantee "for long-term negative consequences". Statistics in the Canadian province of Quebec is very eye opening as they suggest that the youth of Quebec may start drinking earlier and show increased use of substances compared to those of North America. Suggesting that culture may come into choices of substance use. The study showcased that 44.4% of Quebec students, 20% of Canadian students, 29.3% in the United States have consumed alcohol by the time they finish high school. With a following result of 76.5% of Quebec students showcasing data of binge drinking and 10% positive for SUD (substance use disorder). The brain at the time of adolescence has the potential to be more prone to alcohol damage as it's a time for major neuromaturation. This has been showcased through animal testing and few studies have been done on human brains. However, there has been more proof of alcohol induced neurodegeneration through observing human adolescents. There is proved evidence too that alcohol addiction in adulthood is linked to cognitive impairments, with moderate effects reported with adolescents such as effects to verbal and non verbal memory, attention deficits and executive workings as well as visuospatial achievement. Limitations of this study can be considered to being based in America and not examining the entire school population as the data sets as an outcome could have been different and as it is such a fast changing way of life, the amount of alcohol and substances consumed can change daily. AKANBI. M. I et al., (2015) highlights the impact substance misuse has on an adolescent academic performance, based in a college in Kwara State through a survey with the sample of 150 adolescent students in Kwara State and conducted this survey through a t-test which results showcase that there was a significant difference between students that do take drugs and those that don't. Another finding was that there was major gender differences in which used substances more.

Chassin et al., 1999 showcased literature based upon adolescent substance use disorders which are the most important topics known into clinical and public health because of how popular the cases and how associated they are with negative consequences, considering all age groups. Recent estimates by Chassin et al., 1999 suggest that the use of alcohol in heightened amounts and nicotine as well as illegal drugs cost the United States alone around \$257 billion per year. Chassin et al., 1999 stated that many adolescents experiment with substance use without considering consequences, with risks including mortality, morbidity and increased risk of infections such as HIV and smoking-related disease. A major finding in the literature is that adults whose parents have a history of alcohol or drug abuse or substance dependence or such related disorders which concludes that past experiences may contribute to later drug taking or risk behaviour. A further study by Gould T.J., (2010) demonstrated findings that a change in cognitive images much like memory changes with immediate effect with substance use. There has been a number of researchers that have found several reasons in growth with substance use with adolescence, which include peer pressure and the use by peers for example, (Keyzers A et al., 2020) and issues with family such as if parents are using substances which can lead to poor parenting and monitoring stated by Whitesell M et al., (2013). These findings showcase that drug taking is a multi-persuasive area, and that there are elements across all platforms that can contribute to one's choice in doing so from issues with family and their upbringing to friends persuasion or for curiosity reasoning or experimentation or escapism and the feeling of enhancing experiences (Kossoski, V., 2023, June 29).

The adolescent brain is ever changing through this stage in life, it's the stage in which personalities get most altered and emerge by learning new skills and becoming well adjusted and responsible. They are in fact growing into the person they will be for the rest of their lives. This stage in life is when individuals tend to be the most adaptable to new experiences which may cause a drive to taking risky behaviour and try mind-altering substances according to Mally, C. (2023)

Through this stage it is the most crucial to have a good balance of neurotransmitters, these chemicals are key to keeping the body and mind functioning normally as they produce and carry messages to nerve cells and neurons. In a physical context, everything a person thinks and feels are because of these chemical connections such as our mood, memory and pleasure. A few of the key ones that are used are Glutamate which affects the thinking abilities within an individual, Dopamine which is responsible for feelings of happiness and pleasure and Norepinephrine which contributes to support of holding away stress. The human brain is constantly made up of neurons which are protected by a layer called myelin, which acts as the body guard for the messages to safely travel to the brain. The older you get the better your messages are thought to travel (Professional, C. C. M. (n.d.). During adolescence these messages tend to be more extreme, experiences harsher emotions compared to an adult, and because of this when an adolescent takes drugs as a teenager they tend to have a harsher impact compared to an adult which leaves them at a greater risk of addiction.

There are three types of drugs that have key impacts on adolescence such as stimulants which allow the brain to rest and the nervous system to function unusually fast. When taking stimulants the adolescent brain will produce an unusual amount of energy causing high heart rate and temperature (National Institute on Drug Abuse (2023). Depressants cause the brain and nervous system to slow down, causing low mood and low energy levels also causing low heart rate (National Institute on Drug Abuse (2022).

Thirdly, Hallucinogens which affect the brain's perception of reality which affects what the brain sees and hears as well as what they taste and feel. Even things that are not real, they technically just cause the brain to illusionise the world around them. When an adolescent abuses drugs of a great amount, the balance of the neurotransmitters is confused and is lost as the pathways have been altered. Many substances deplete the brain's production of dopamine, serotonin which oversees body functions, mood stabilization as well as cognition (National Institute on Drug Abuse (2022). To conclude, there are a number of substances that affect the brain in different ways especially cognitively, as the literature

has stated it is the most crucial aspect anything needs in order to think properly and any early onset of damage will affect the brain function in the future, being minor to quite severe as previously mentioned by the literature studies. Endorphins which are another key chemical for happiness. As a result to these altered paths the drugs trick the brain to reward the person for taking the substances instead of healthy aspects in life such as eating, sleeping or social interaction. Excessive use of illegal substances can cause substantial damage to a brain's prefrontal cortex which is the store house for decision making and social interactions and the ways in which self control is housed. With certain drugs the brain fails to develop these areas and can become multifunctional. The more drugs that are used the more critical areas of the brain that are affected which includes other areas such as emotional development, sensory perception and the ability to experience feelings and concentration and permanent damage can result in aspects such as loss of memory, coordination, dependency and mental health disorders. Abdulaal, A., et al (2023) studied the cognitive effect that substance use has on the brain, knowing that cognitive issues were very prevalent in many health issues linked to substance use with adolescents. The aim being to investigate the cognitive aspects of the brain most affected in sample adolescents with known substance use disorders. It was a study done with 100 substance users with 40 controls within a case-control comparison. A lot of individuals who use drugs or alcohol started when they were teenagers or within early adulthood according to several studies, including using illegal substances and having a large amount of alcohol and having prescription medicines. According to this study 70% of high school kids have tried alcohol, 50% had used drugs and 20% had used prescription medicinal drugs for other reasons than for their actual purpose.

In conclusion, this literature review has covered several reasons to why and how adolescents get affected by drug use cognitively and how it affects academically (Brown, S. A et al., 2004). The literature suggests that adolescents that abuse substances at this stage in life will get affected heavily once they are older and consequence in different ways (Lubman, D. I., et al (2007). Substance abuse at this stage of life can be a consequence of a number of reasons, such as peer pressure and possible complicated upbringing (Macleod *et al.*, 2004) However, other literature highlights some of the positive aspects of drug-use such as medicinal usage for mental health disorders, which help individuals cope better with their brain activity (Kossoski, V., 2023). Therefore, after carefully analysing the literature, addressment for future ideas would be to encourage conversations with schools and children as well as parents to raise awareness of the drug affects later in life (Nspcc., n.d.). Continued (Griffin KW et al., 2010) suggesting that prevention programs will contribute to help adolescents to not be influenced or help them through addiction or past drug use.

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