Attention Deficit Hyperactivity Disorder and Substance Use Disorder: Early Assessment and Treatment

Anika Stasiak

Justin Borkowski

Raghad Alagha

Raphael Palmeira Daenekas Jorge

Psychology Department, Douglas College Psychology

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Dr. Nicole Vittoz

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Proposal

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most prevalent mental disorders in treatment and recovery centers (van de Glind et al., 2014). Thus, this suggests comorbidity between ADHD and substance use disorder (SUD). As a result, we believe that early treatment of ADHD could help prevent future SUD. Furthermore, early education and assessment would allow more children with ADHD to get the treatment they need before issues arise. Additionally, we suggest that more specialists be employed in schools to allow for an accurate and effective diagnosis of ADHD. Finally, we propose that psychological treatments, whether those be therapy or pharmaceuticals, be covered by healthcare. We can ensure that all children can get the treatment they need to treat ADHD and prevent future SUD.

Prevalence of ADHD and SUD

ADHD is a mental disorder characterized by an inability to pay attention and hyperactivity. According to the DSM-V, someone can be diagnosed with ADHD if they show at least six symptoms relating to inattention and six symptoms relating to hyperactivity (American Psychiatric Association, 2013). From an article published in the Canadian Journal of Psychiatry, between 1994 and 2007 the prevalence of ADHD diagnoses and ADHD medication use amongst youth was nearly 5% (Brault & Lacourse, 2012). However, over the next decades, ADHD diagnosis in school-aged children doubled. Furthermore, it was found that ADHD contributes significantlyto the early onset and severity of nicotine dependence, with greater prevalence in boys thangirls (Riggs et al., 1998).

Another way in which people with ADHD attempt to increase their norepinephrine and dopamine levels is through self-medication. Self-medication is when an undiagnosed person with ADHD looks to drugs to alleviate their symptoms. These drugs are not prescribed and can range from coffee, over-the-counter drugs, or recreational drugs such as marijuana (Ágoston et al., 2022).

The dangers of self-medication are ample. According to research, nearly 25% of people in treatment centers for substance and alcohol abuse suffer from ADHD (Watson, 2020). Furthermore, among people with ADHD, 21% of boys and 13% of girls end up abusing some sort of substance. Additionally, a study conducted in a South London detoxification unit found that about 15% of their sample had undiagnosed ADHD (Huntley et al., 2012). Individuals with undiagnosed ADHD were approximately five times more likely to have SUD than the general population (Huntley et al., 2012). This evidence suggests that individuals who are not receiving the treatment they need and are self-medicating are at greater risk of developing addictions.

Background

The causes of these attention and hyperactivity symptoms can be traced back to catecholamines, which are involved in activating certain parts of the brain. The transporters of people with ADHD tend to remove norepinephrine and dopamine from the synapse too quickly resulting in fewer of these neurotransmitters overall (Arnsten, 2009). As a result of this deficit, individuals often need to resort to more drastic means to stimulate their dopamine pathways to motivate behavior. The impulsive nature of ADHD characterizes this;individuals are acting on their impulses to compensate for their lower levels of catecholamines (Arnsten & Dudley, 2005)). Consequently, individuals are subjected to less dopamine and norepinephrine, resulting in less activity in the dorsolateral prefrontal cortex (Colzato et al., 2009). The dorsolateral prefrontal cortex is involved in executive functions such as inhibition. When it is less active, one’s inhibitive abilities are similarly less active. Without inhibition, people with ADHD are not able to easily control their impulsive behaviors. A preventative measure to protect people with ADHD from developing SUD is to educateparents and children. In Canada, psychologists are required by law to get the informed consent of all legal guardians before performing assessments on a minor (Coughlin, 2018).By educating parents on this topic, perhaps more children properly assessed and given proper treatment.

There are, however, cases where the informed consent of guardians is not required. According to the infant's act, youth can give informed consent for medical procedures given

that they are fully informed and capable of making mature decisions (British Columbia Statute Citator, 1996, Chapter 223, Section 17). By educating parents and children about ADHD and encouraging them to get a diagnosis from a specialist, we can ensure that fewerpeople with ADHD suffer from addictions in the future.

Unfortunately, there are barriers preventing people with ADHD from getting the treatment they need. One of these issues is a lack of professionals who can accurately identify ADHD. As a result, people often go to non-specialists who cannot give a proper diagnosis, such as a general physician (Society for Children and Youth of BC, 2020).

Another issue is that there is no universal health care for pharmaceuticals and therefore, medication is unavailable for children from low-income families. As of now, ADHD medications such as methamphetamines are some of the best ways to treat the symptomsof ADHD. Behaviorally, these medications both increase attention and decrease hyperactivity in people with ADHD (Castells et al., 2018). The medications are stimulants that reduce the reuptake of norepinephrine in the dorsolateral prefrontal cortex. This part ofthe brain is associated with impulse control; therefore increasing activity in this area shouldreduce the hyperactive, impulsive behaviors of ADHD (Hoppenbrouwers et al., 2013).

The solution we propose comes in four parts. First, we need to educate parents and children about ADHD, how it can be treated, and the risks involved if it goes untreated to encourage assessment and diagnosis. Second, we suggest that a greater emphasis be placed on the hiring of school psychologists so that a proper diagnosis can be made since, without a proper specialist, ADHD may be improperly assessed. Thirdly, the Foundry system, a free-of-charge treatmentcenter, should become a model for provincial healthcare that reduces inaccessibility to health care services. Finally, we would propose that pharmaceuticals be covered by universal healthcare. Early assessment and treatment are essential and provide children with the medication they need in order to prevent addiction in the future.

Biological Basis and Mechanism of ADHD

Studies have shown that ADHD is associated with a specific chemical environment in the prefrontal cortex (Arnsten, 2009). ADHD is associated with a weaker function of the prefrontal cortex circuits, especially in the right hemisphere, or the dorsolateral prefrontal cortex. The prefrontal cortex is responsible for executive function that allows us to organize and plan for the future while simultaneously inhibiting distraction responses in order to achieve long-term goals. However, the downside to addiction in adolescents is that the prefrontal cortex does not mature until late adolescence (Arnsten, 2009; Lewis, 2015).

The prefrontal cortex contains pyramidal cells that are sensitive to regulation by norepinephrine (NE) and dopamine (DA) to excite nearby neurons. Dopamine (DA) and norepinephrine (NE) are responsible for increasing or decreasing the strength of neurotransmitter signaling through a secondary messenger cAMP system (Arnsten, 2009). The cAMP mechanism signals hyperpolarization- cyclic voltage-gated channels (HCN) to either depolarize the membrane through an influx of sodium (Na+) or hyperpolarize through an influx of potassium (K+) (Arnsten, 2009). When NE attaches to alpha 2A receptors, it causes an influx of K+ into the postsynaptic cell, which closes the HCN by decreasing cAMP signaling (Arnsten & Dudley, 2005). Consequently, this likely enhances signaling between neurons and increases an individual's focus on a specific task or goal. When DA attaches to D1 receptors, it causes an influx of Na+ into the postsynaptic cell, which opens the HCN by increasing cAMP signaling (Arnsten, 2009). Thus, decreasing signaling between neurons, decreases focus on certain environmental stimuli, such as ignoring noises. NE and DA work together at the pyramidal cell to increase focus on a specific task or environmental stimuli while simultaneously decreasing irrelevant stimuli.

Addiction Mechanism and ADHD Medication Treatment

Addiction is an unintended consequence of learning in the brain (Lewis, 2015). Addiction occurs from habits that start from cravings, or impulses, which lead to compulsions and, if continuously reinforced, addiction (Lewis, 2015). However, some compulsive habits are necessary for survival. For example, teeth brushing is not something one must consciously think

about accomplishing. This mechanism increases efficiency by reusing the already established neural pathways to think and perform more important actions throughout the day (Lewis, 2015). However, some behaviors, such as compulsive drug use, release more dopamine from the midbrain than teeth brushing (Lewis, 2015). Therefore, addiction becomes an unintended consequence of learning, constantly fueled and chemically reinforced by dopamine surges (Lewis, 2015).

After drug exposure, the brain will learn that this is a source of euphoria. Thus, the amygdala stores any emotional reminders and perceived benefits of the experience that stimulate intense desire in the brain (Lewis, 2015). The convergence of neurons "pave" six-lane "highways" from the dorsal striatum, responsible for impulses and cravings, to the ventral striatum, responsible for compulsion formation (Lewis, 2015). After multiple uses of the drug, the dorsal striatum becomes uncoupled from the control centers in the dorsal lateral prefrontal cortex (Lewis, 2015). Once the compulsion pathway has been "paved", the dorsal striatum receives information from the amygdala (emotional reminder), visual cortex (visual reminder), and the midbrain, which receives ample amounts of dopamine from the brainstem, causing an intense desire for the drug. At the same time the dorsal striatum is no longer affectively regulated by the dorsolateral prefrontal cortex, minimizing self-control (Lewis, 2015).

ADHD is linked to genetic malfunctions that weaken catecholamine signaling in the prefrontal cortex (Arnsten, 2009; Sesack et al., 1998). Specifically, some studies have shown genetic deficits in NE and DA transporters that are associated with lower NE and DA transmitters in the synaptic cleft (Arnsten & Dudley, 2005). Stimulants such as Adderall (amphetamine), Vyvanse (lisdexamfetamine dimesylate), and Ritalin (methylphenidate) are drugs responsible for treating ADHD symptoms by increasing NE and DA (Arsten, 2009). These stimulants act as receptor agonists, blocking reuptake oft NE and DA through the transporters, thus, stabilizing the chemical environment in the synapse (Arnsten, 2009; Sesack et al., 1998). Stimulants appear to increase NE activity at alpha 2A receptors that close "leaky" HCN channels, which in turn increase attention (Arnsten & Dudley, 2005).

Since the prefrontal cortex does not reach maturation until later adolescence, vulnerable youths do not have enough developed foresight towards the consequences of using drugs. Thus, the right chemical environment that is introduced with ADHD medication could prevent the development of addiction by increasing the neuronal pathways to the control centers in the dorsolateral prefrontal cortex. Since ADHD is associated with weakened catecholamine signaling as the result of genetics, early intervention in youths with potential ADHD symptoms might help the prefrontal cortex suppress irrelevant information, enhance the processing of relevant stimulation, and enhance inhibitory control over behavioral impulse (Arnsten, 2009)

Systemic Issues and Solutions for Assessment and Treatment of ADHD

Our proposal is that ADHD medication can help prevent substance use disorder by acting on the NE and DA transporters to increase control and attention on goal-oriented tasks (Arnsten, 2019). Moreover, a specific chemical environment is necessary for maintaining neurons in the dorsolateral prefrontal cortex (Arnsten & Dudley, 2005). As described previously, when youth are in active addiction, these neurons are pruned and rearranged to merge with the developing major highways from the dorsal to the ventral striatum, exposed to excessive dopamine from the brainstem. Thus, an early assessment might provide several benefits for youth struggling with ADHD, because intervening early decreases the likelihood that these control pathways are pruned.

However, there are potential barriers that would impede vulnerable youth from having access to treatment. Namely, there are concerns with consent, especially for children below grade 9, since there is a gray legal boundary for minors' ability to provide consent to medical procedures (Practice Guideline on Consent for Children and Youth, 2019). Moreover, other barriers include access to medications, access to assessment personnel in schools, or eligibility for governmental assistance programs.

From the standards established by the Canadian code of ethics for psychologists (2017), professionals must obtain informed consent from all individuals and legal guardians for any psychological services offered (Canadian Psychological Association, 2017, Section I.19).

Similarly, in the code of conduct of the College of Psychologists of British Columbia (CPBC) (2014), it is specified that the client, in order to provide informed consent, must have sufficient information about the nature of the procedure (College of Psychologists of British Columbia, 2014, Section 4.2).

A common factor in determining whether one has a legal entitlement to provide consent is their maturity to comprehend what the treatment entails, risks and benefits, and so on. Age, however, is not a determinant of one's ability to provide informed consent, as enacted in the Infants Act (British Columbia Statute Citator, 1996, Chapter 223, Section 17). The legislation imposes that youth are able to provide mature minor consent under the aforementioned circumstances, and in common practice that entails children from grade 9 and beyond (HealthLinkBC, 2021).

The policies stated above implicate that child of all ages can provide consent if they are deemed mature enough. However, most children below grade 9 are not usually "mature", and therefore need guardian consent in order to engage in treatment. An issue is that some parents do not agree ideologically with medicating their children despite the evidence-based support for the efficacy of ADHD medication. In addition, studies suggest that one of the primary reasons for parental disagreement with medicating their children has to do with inadequate health and medical literacy (Ferguson & Pawlak, 2011). Thus, for children below grade 9 who do not meet the maturity criteria and cannot obtain proper treatment, our intervention would focus on educating parents on the importance of such treatment, such as sending pamphlets to homes, or lectures during guardian meetings in schools.

Another potential issue with consent is that children that meet the criteria for maturity might not be aware of what the symptoms of ADHD entail, causing them not to seek an assessment. Therefore, our intervention for mature minors would focus on introducing posters into their schools that provide a description of the symptoms of the disorder, in order to increase awareness.

Despite the educational component of our intervention, there are additional barriers that

would impede the process of ADHD assessment and treatment which are beyond health literacy. According to the health and other support services division in the School Act, “A board must provide health services, social services and other support services for schools in accordance with any orders made by the minister” (British Columbia Statute Citator, 1996, Chapter 412, Section 88). Thus, it is stated in the legislation that schools should hold mental health support staff. However, this does not reflect the reality in public schools (Society for Children and Youth of BC, 2020). The office of the representative for Children and Youth, alongside other institutions, also contends that there are too few school counselors, poor working conditions due to chronic underfunding and that they are inaccessible for some students (Society for Children and Youth of BC, 2020). The lack of personnel capable of conducting assessments provides a barrier once youth seek assessment and may exacerbate their vulnerability by untimely assistance.

In light of these difficulties, a recent non-governmental report (NGO) suggests that a solution to the availability of personnel would be for the government of BC or Canada to implement incentive programs for school counselors or other professionals to practice in youth communities like schools (Society for Children and Youth of BC, 2020).

In addition to the lack of accessibility of professionals through schools, the same trend can be observed in the public health system. In order for a psychological procedure to be covered by BC’s Medical Services Plan, one must demonstrate to a physician that they need urgent mental health care in order to receive a referral (Society for Children and Youth of BC, 2020). These can only be acquired in cases of suicidal ideation or attempt, and crises followed by hospitalization (Society for Children and Youth of BC, 2020). However, the symptomatology of ADHD does not fit those criteria; thus MSP excludes this demographic from subsidized mental health treatment, coercing children to finance their own. Even if one fits the urgency criteria, waitlists for psychiatrist consultations can range from six months to a year (Society for Children and Youth of BC, 2020).

Compounding the problem of access, there is no universal coverage for pharmaceutical treatments either, despite the fact that the preferred mode of treatment in Canada is

pharmaceutical interventions (Society for Children and Youth of BC, 2020). Although there is a governmental program for pharmaceutical assistance, named PharmaCare, those that do not fit its criteria must support their own treatment, which might not be financially feasible. The federal and provincial governments should strive to universalize access to pharmaceutical therapies, given how common their use is across Canada.

A way to address this financial barrier to treatment, as per the NGO report, would be to have the health care system emulate the Foundry model. Foundry is a provincial network of centers that provide counseling and support to youth ages 12-24, free of cost and subsidized by the Canadian government (Society for Children and Youth of BC, 2020). However, not many people are aware of Foundry, thus mentioning this foundation in the posters, pamphlets, and meetings previously suggested as solutions would disseminate awareness of its services. Since therapeutic interventions take large amounts of time and are expensive due to being uninsured, the Foundry model provides an alternative to the current public healthcare system that is more accessible for those in need.

Ethical doubts and controversies in Medicalization and Diagnosis in Youth

The mental health system operates within the medical model and relies heavily on prescribing medications (Society for Children and Youth of BC, 2020). Although there are many forms of treatment for a mental disorder like psychotherapy and community care, medications are the first option offered to people after a mental health diagnosis (Newlove-Delgado et al., 2018). ADHD diagnosis has increased significantly over the last few years, which is mainly due to medical professionals over diagnosing children and misinterpreting children's behaviors for signs of ADHD, which led to an increase in prescribing antidepressants and ADHD medication (Newlove-Delgado et al., 2018).

Off-label medicalizing of children is a major issue facing children with ADHD (Di Pietro & Illes, 2014). There has been a massive increase in the prescription of psychiatric medications over the last 10 years despite the lack of evidence for their efficacy. Antipsychotic medication has been prescribed for ADHD, which is off-label and not safe (Di Pietro & Illes, 2014).

Antipsychotic medication use for nonpsychotic disorders is not approved by Health Canada, due to many side effects, high blood sugar, weight gain, hyperprolactinemia, and reflex movement (Di Pietro & Illes, 2014). This study focused on educating physicians about the limit of scientific evidence supporting the use of antipsychotic medication to treat youth. Physicians should treat patients' needs by utilizing other forms of treatment including nonpharmacological ones and only use medications as a last resource (Di Pietro & Illes, 2014).

The outcomes of using medications to treat ADHD differ in short term and long term. In the short term, medications are fast and very effective in treating ADHD symptoms compared to other forms of treatment (Molina et al., 2009). However, In the long term, studies have found that medications work just as well as other forms of treatment, such as behavioral therapy and community care (Molina et al., 2009). A research study compared 4 groups of children who were treated using the following treatments: medication, behavioral therapy, a combination of medication and behavioral therapy, and community care (Molina et al., 2009). The findings indicated that medications and the combination of medication and behavioral therapy were most effective in the first 24 months (Molina et al., 2009). However, after 3 years, a follow-up study claimed that all treatment options were effective in treating ADHD symptoms (James et al., 2001; Molina et al., 2009). In addition, studies suggest that ADHD medication causes dependency in long-term users, which supports why using other forms of treatment is more ethical than using medication (Molina et al., 2009).

ADHD medication comes with many unpleasant short-term side effects, which include trouble sleeping, aches, nausea, loss of appetite, and social withdrawal (Society for Children and Youth of BC, 2020). Since the side effects are undesirable, looking at other forms of treatment for ADHD might be a better option (Molina et al., 2009). There is a disagreement in the literature about the long-term effects of using ADHD medications with some studies suggesting that the medication might affect the physical growth of children, through loss of appetite (Molina et al., 2009). However, if short-term side effects are properly managed, then long-term effects can be prevented.

Conclusion

Studies have found that ADHD is comorbid with SUD. As such, we hypothesized that early assessment and treatment of ADHD can help reduce the vulnerability to SUD. Based on the literature, it is apparent that ADHD medication provides increased impulse control by maintaining the proper chemical environment in the prefrontal cortex (Arnsten, 2009; Arnsten & Dudley, 2005).

There are different forms of treating ADHD like CBT or community care, which have proven to be as effective as medication after approximately three years. Furthermore, there has been an increased concern with overmedicalizing youth due to improper ADHD assessment and diagnosis. Despite that, medication appears to be a more cost-effective and time-efficient way to treat ADHD, and thus should be the target for governmental prevention strategies (Molina et al., 2009).

Concurrently, statistics report that approximately 21.6% of Canadians during their lifetime will meet the criteria for SUD (Statistics Canada, 2012). The South London detoxification center reports that 12% of their client population had undiagnosed ADHD (Huntley et al., 2012). Thus, by extrapolating the data from the aforementioned study to Canada's SUD incidence, we estimated that around 0.9 million Canadians of the 7.65 million with SUD, could have untreated comorbid ADHD.

Considering the discrepancy between the idealism of policies and everyday practice, it is imperative that the provincial government implement solutions to alleviate these differences. In accordance with the NGO report, we suggest that the government distribute more school psychologists to understaffed schools by increasing monetary incentives (Society for Children and Youth of BC, 2020). Similarly, for those without the financial capacity to pay for counseling, the Foundry system offers a viable free of charge alternative, and we suggest bringing awareness to the program through posters and teacher suggestions. Furthermore, we suggest increasing health awareness to youth and parents by providing informational posters in schools about ADHD's symptomatology. Lastly, we also suggest for the federal and provincial governments to

universalize pharmaceutical expenditure, as it is a common form of treatment for many mental disorders.

Following the famous saying from Thomas Jefferson “An ounce of prevention is worth a pound of cure”, increases in funding of youth mental health programs might, over the long-term, be more inexpensive to the provincial and federal governments than crisis management of SUD. A report from the University of Victoria (2007-2014) stated that the cost of substance use in Canada was $38.4 billion (Canadian Centre on Substance Use and Addiction, 2014). In the best-case scenario, the prevention of SUD in people with ADHD could save 4.6 billion dollars that are spent on treatment. In addition, the benefits could also expand far beyond the realm of SUD prevention, as they may allow for further youth self-actualization and academic achievement.

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