Review Paper

Critically Discussing the Biological and Social Aspects in the Treatment of Substance use Disorder

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ABSTRACT

It is estimated that approximately 35 million people suffer from substance use disorders (SUDs). SUDs are complex and chronic conditions that involve the continued use of a substance despite its harmful consequences. Various factors, such as genetics, biology, and social influences, play a significant role in the development of the disorder. Comprehending the biological mechanisms of substance use and the social factors and early life experiences that shape the development of SUD is crucial for designing effective treatment approaches. This can include medications that directly target the mechanisms of action of substances, like in the case of nicotine, or medications that indirectly address the adverse effects of substance withdrawal, like in the case of cocaine. Effective non-pharmaceutical interventions, like cognitive behavioral therapy (CBT) and contingency management (CM), are available for individuals with SUD. Research has shown that the combination of medication and non-pharmaceutical approaches offer the most effective and long-lasting effects, especially when combined with a supportive environment.

Keywords: Substance Use Disorder, Biopsychology, Social Psychology, Treatment

Approximately 5.5% of the global population was reported to have used psychoactive drugs within the last year. Moreover, around 35 million individuals are estimated to suffer from substance use disorders (SUDs), and about 0.5 million deaths are attributable to drug use each year (Wold Health Organization [WHO], 2023). SUDs are intricate and often chronic conditions characterized by the persistent use of a substance despite the negative repercussions it may cause. (Butelman & Kreek, 2017). In turn, "substance" is defined as any psychoactive compound that could potentially cause social and health issues, including addiction. Some substances, like alcohol and tobacco, are legal. Others, such as heroin and cocaine, are illegal. Additionally, there are substances like hydrocodone and oxycodone, which are controlled and can only be used under the supervision of

licensed prescribers for medical purposes. (McLellan, 2017).

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) is regarded as the defining standard for mental health diagnoses, including SUDs. The DSM-5 identifies SUDs as primary mental health disorders (Robinson & Adinoff, 2016). It has also redefined addiction as a "substance use disorder," stressing the compulsive aspect of drug seeking (Lüscher, 2020). According to the DSM-5, for the diagnosis of SUD, the presence of at least two signs within a year is required. These may include persistently seeking substances despite potential health risks, experiencing intense cravings, neglecting social and work-related commitments, developing a tolerance -i.e. reduced sensitivity or diminished response to the effects of the substance- to the substance, and encountering withdrawal symptoms -i.e. negative emotions in the absence of the substance- (American Psychiatric Association [APA], 2022).

Individuals with SUD often become consumed by their need for substance use, which can greatly hinder their daily functions. This preoccupation with substance use persists, even when they are fully aware of the negative consequences it brings. Severe SUDs, or addictions, can cause distorted thinking, changes in brain structure, intense cravings, and even changes in personality (APA, 2013).

By exploring the biological and social aspects of SUDs, this essay aims to elucidate the complexities of this condition and also to discuss the effectiveness of current treatment approaches with regard to physiological and sociocultural factors that contribute to the disorder.

Research suggests that a significant portion of the variability in addiction risk can be attributed to genetic factors. There are a limited number of gene variants that have been discovered to either increase the risk of addiction or provide protection against it, suggesting that multiple genes play a role in addiction development. Studies have found a correlation between addiction risk and genes that play a role in strengthening neuronal connections and forming drug memories (Substance Abuse and Mental Health Services Administration (US) & Office of the Surgeon General (US), 2016). A great illustration of such genes could be the gene clusters CHRNA3, CHRNA5, and CHRNAB4, which show a higher vulnerability to nicotine addiction (MacNicol, 2017). However, research has shown that environmental factors can affect behaviors linked to particular genes. For instance, twin studies have demonstrated that being raised in secure environments and in the absence of early-life traumas can impact gene expression regarding addictions (Ducci &Goldman, 2012).

Even though genetics can impact the formation of SUD, it is important to understand the biological mechanisms underlying this disorder. More precisely, SUD involves changes in the brain that affect the way individuals experience pleasure, reward, and control impulses. Hayes (2020) coins that the dopaminergic mesocorticolimbic pathway connects the ventral tegmental area (VTA) to the striatum and prefrontal cortex (PFC) and that this pathway is often linked to reward. Drugs of misuse can manipulate the reward system by significantly boosting dopamine levels in the striatum, specifically in the limbic or ventral striatum, surpassing the effects of typical rewards such as food and sex (Hayes et al., 2020).

On the cellular level, these areas are interconnected through two main types of brain circuits. One type is a precise point-to-point system, where each neuron forms a single connection with another neuron, whereas the other type is a diverse system, where a neuron forms multiple connections with several different neurons. The point-to-point system commonly employs amino acids like glutamate, γ-aminobutyric acid (GABA), aspartate, and glycine as transmitters. It is accountable for specific actions, such as movement and sensation. The system is composed of various

neurotransmitters, such as dopamine, serotonin, and acetylcholine. Its purpose is to regulate neural responses according to the body's homeostatic requirements. In substance consumption, these substances mimic various of these neurotransmitters (MacNicol, 2017).

A great illustration of a substance mimicking a neurotransmitter could be the stimulant cocaine. More precisely, cocaine blocks the presynaptic dopamine transporter (DAT) in the brain. By inhibiting the reuptake of dopamine, cocaine leads to an accumulation of dopamine in the synapses between nerve cells. The increased concentration of dopamine in the synapses contributes to the euphoria and heightened arousal associated with cocaine use (Hayes et al.,2020; Koob & Volkow, 2010).

Another great example of a substance hijacking the nerve cells is nicotine, found in tobacco products. Nicotine binds to the nicotinic acetylcholine receptors, stimulating the release of various neurotransmitters, including dopamine. The release of dopamine in the brain's reward pathway contributes to the pleasurable sensations and reinforcement associated with nicotine use (Butelman & Kreek, 2017; Hayes et al., 2020; Koob& Volkow, 2010).

There can be variation in how each individual's brain adapts to repeated substance exposure. Neuroadaptive alternations such as changes in the receptor sensitivity or neural circuity can vary among individuals. Therefore, some users may undergo more significant neuroadaptations resulting in a quicker progression towards addiction (MacNicol, 2017).

Understanding how the substances affect the nervous system is crucial to finding an effective treatment. In the case of legal drugs such as nicotine, there are several FDA-approved medications. These are nicotine replacement therapy (NRT), bupropion, and varenicline. More specifically, NRT includes nicotine gum, nicotine lozenges, nicotine patches, nicotine inhalers, and nicotine nasal spray. NRTs effectively stimulate the brain receptors affected by nicotine, providing relief from withdrawal symptoms and cravings that often result in relapse. Numerous individuals rely on NRT as a helpful aid during the initial phases of quitting smoking, while individuals with more intense nicotine addiction can find longer-term treatment to be advantageous (Butelman & Kreek, 2017; Le Foll et al., 2022; NIDA, 2021; Reddy et al., 2020). Bupropion functions by reducing the appeal of tobacco to individuals. This mechanism of action involves the inhibition of the reuptake of the brain chemicals norepinephrine and dopamine while also promoting their release. Studies have shown that bupropion effectively enhances smoking cessation rates (Le Foll et al., 2022; NIDA, 2021). Finally, varenicline functions by inhibiting the nicotine-sensitive regions of the brain. Varenicline effectively reduces nicotine cravings by stimulating the alpha-4 beta-2 nicotinic receptor, although to a lesser extent compared to nicotine. Research has shown that using varenicline significantly increases the chances of quitting smoking and has a higher success rate compared to placebo and single forms of NRT and bupropion (NIDA, 2021).

Cocaine is a major factor contributing to overdose deaths related to illicit drug use in both the US and the United Kingdom. Despite numerous clinical trials conducted over the years, there is still a lack of approved pharmacotherapy for cocaine use disorders (Bentzley et al., 2021). Recent studies have shown that the most effective therapies for CUD do not involve direct medication. Instead, they target the adverse effects that occur once the substance has left the human body. In recent studies, researchers have explored the benefits and drawbacks of using antidepressants like bupropion, sertraline, venlafaxine, and mirtazapine (Chan et al., 2019). The findings provided strong evidence for the effectiveness of antidepressants, particularly bupropion, in reducing substance use, promoting abstinence, and improving treatment retention (Chan et al., 2019; Gao

et al., 2023). Moreover, cannabidiol is being regarded as a potential treatment for CUD. Multiple studies have examined the effects of CBD on experimental models for treating CUD. These have found that cannabidiol (CBD) possesses anxiolytic, antipsychotic, and anticonvulsant properties. and is involved in regulating the motivation circuitry of patients (Rodrigues et al., 2020). While biological and genetic factors can impact the manifestation of SUD, the patient's social environment is also considered a significant indicator of the disorder. There have been many social theories proposed to better comprehend the causes of addiction. There is a strong connection between attachment theory and the development of SUD. More specifically, attachment theory suggests that the bonds that infants and children form with their caregivers affect their social and emotional development throughout their lives (Liu & Ma, 2019; Rinker, 2019). According to Schindler (2019), it is more likely for an individual who has not experienced secure attachments when growing up to develop not only SUD but also many other mental disorders. The term secure describes the relationship that the child has with their caregivers in terms of distance and closeness. The offspring seek closeness to their parents when they feel in danger, and their parents' comforting establishes a secure bond, which in turn helps the child regulate their emotions. In the case that the parents neglect their child's need for affection or comfort, the bond is insecure, the child fails to regulate their emotions, and feels fearful and anxious. In the case of SUD, the substance is used as a self-medication, aiming to compensate for the lack of attachment strategies (i.e., strategies that the individual can use to regulate their emotions and stress) and/or replace relationships with others (Liu & Ma, 2019; Rinker, 2019; Schindler, 2019). The nature of the substance also shows the level of security that the individual seeks, as well as the different strategies for coping with negative experiences in close relationships.

For example, individuals with preoccupied patterns can follow hyperactive strategies, hoping for closeness to their important others. Notably, the abuse of stimulants such as cocaine might be linked to more hyperactivating, closeness-seeking attachment strategies (Schindler, 2019). Poor parenting and parental substance use have always been indicators of offspring substance use (Zucker & Brown, 2019). Furthermore, literature suggests that social learning theory could also be considered a crucial factor in the development of SUD. According to this theory, individuals, through social interactions, are exposed to their associates (family, peers, and tutors) who engage in certain behaviors. This is a two-dimensional concept; either the individuals are exposed to their associates' behavior directly or they are exposed to norms and morals through their associates. By observing the behavior of others, individuals decide whether an act is justifiable, and they proceed with imitating or modelling that act. If this behavior is then accepted and reinforced with rewards, it is more likely that the individual will repeat it. In this way, the behavior and moral judgement around an act are set (Kruis et al., 2020). According to research, individuals who have been witnesses to drug use within their family and those whose friends are users tend to hold a favorable attitude towards drugs. Consequently, they had greater chances to use drugs themselves. On the contrary, individuals who were raised in healthy environments and surrounded by peers who had never been users had a lesser chance of experiencing the disorder and a greater likelihood of adopting a healthy lifestyle (Barnes et al., 2006; Kruis et al., 2020). Drawing on the principles of attachment theory and social learning theories, many effective non-pharmaceutical interventions have been found for patients suffering from SUD. These mainly focus on individual efforts to quit the addiction and improve the lifestyle of the patients. In the case of legal substances such as tobacco, there are

numerous approaches. A widely accepted method is cognitive behavioral therapy (CBT). CBT incorporates social learning theory, classical conditioning, and operant conditioning to assist individuals in identifying external triggers that could put them at risk of relapsing and offers them techniques to develop more positive and constructive behaviors, replacing harmful patterns with healthier alternatives (Easton, 2018). Moreover, in a study focused on tobacco use disorder, it was found that patients treated with six sessions of CBT had higher success rates than those who followed a nicotine replacement treatment (Webb, 2010). However, it is important to point out that motivation also plays a crucial role in the success of the user. Thus, another treatment approach could be motivational interviewing (MI). More precisely, in MI the clinicians assist patients in examining and resolving their concerns about quitting and boosting their drive to adopt healthier habits. MI prioritizes the needs of patients and adopts a non-confrontational approach. Healthcare providers highlight any inconsistencies between patients' goals or values and their current behaviors (NIDA, 2021).

When it comes to certain situations where there are no approved medications, such as with cocaine use disorder, psychosocial treatment is currently considered the standard approach. There are various psychosocial treatments available that have been shown to be effective for CUD. Group counselling and individual drug counselling are widely used as effective treatments. Research has demonstrated the effectiveness of cognitive behavioral therapy (CBT) and motivational interviewing as well (Kampman, 2019). According to Kampman (2019), in the case of CUD, the most effective approach would be contingency management (CM), which is a voucher-based reinforcement psychosocial treatment. In this type of therapy, patients are provided with vouchers that can be used to obtain goods and services in the community. These vouchers are given as a reward for reaching a specific therapeutic objective. Research has shown that CM treatment is particularly successful in encouraging individuals to abstain from cocaine use in the first stages of the treatment (Kampman, 2019; Le Fol et al., 2022; McPherson, 2022).

On a societal level, recognizing the significance of social relationships in the recovery process can greatly assist society in supporting individuals fighting with SUD. According to Pettersen et al. (2019), it is crucial for the patient to change their social network in order to successfully start and maintain abstinence. Social networks may have a significant impact on behavior change, and the quality of relationships in treatment settings can either support or hinder recovery. Thus, the concept of recovery capital (RC) is offered as a theoretical framework to understand how social relationships contribute to recovery from SUD. RC encompasses a range of factors, such as social capital (family, friends, and social networks), physical capital (income and property), human capital (education, skills, hopes, and health), and cultural capital (values, beliefs, and attitudes). This model is useful for analyzing and enhancing social position, identity, and positive network formation (Pettersen et al., 2019). Psychosocial counselling significantly increases the likelihood of success in SUD treatment, especially when combined with pharmacotherapy. The integration of these various approaches can lead to a comprehensive and holistic approach to treating SUD (Le Foll et al., 2022).

In conclusion, SUD is a severe condition that affects a significant portion of the population. Therefore, understanding the nature of addiction and its impact on an individual's life is crucial. More importantly, the various aspects of SUD should be acknowledged and addressed in order to treat such a condition. These include genetic, biological, and social factors that affect and are closely linked to addiction. The biological mechanisms behind substance use and how the

substances affect the brain should be evaluated when it comes to the comprehension of this disorder. Social factors, such as poor parenting, neglect, and growing up in an environment around substance users, have been identified as predictors that impact substance use in adults. Understanding the factors and mechanisms surrounding SUD is essential for successful treatment, increasing the chances of recovery and lowering the likelihood of relapse. Various treatments have been found to assist with SUD, either by directly acting on the addiction, like in the case of varenicline used for nicotine addiction, or indirectly targeting the side effects of the substance use, such as in the case of cocaine, where antidepressants alleviate the adverse effects after the substance leaves the body. Non-pharmaceutical approaches, such as cognitive behavioral therapy and contingency management have also been proven to be significantly effective in treating nicotine addiction and cocaine use disorder, respectively. Additionally, social relations and society plans play a crucial role in the patient's recovery. It is important to acknowledge that the combination of medication, therapy, and a supportive environment is considered the most effective and long-lasting treatment for SUD so far. However, many results from drug trials are still anticipated, and more research related to this disorder should be conducted in order to fully understand its causes, symptoms, and potential treatment options. Moreover, it is crucial to investigate the long-term effects of these interventions on patients and determine their overall results in managing the disorder.

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