REVIEW ARTICLE

ATTENTION DEFICIT HYPERACTIVE DISORDERS (ADHD) AND SUBSTANCE USE DISORDERS: OVERLAP, COINCIDENCE OR FATE?

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Abstract

The link among ADHD and addiction is increasingly shifting into the focus of scientific study. It becomes obvious that ADHD functions as a risk factor and condition for dependence. Disturbances in psychosocial functioning and the tendency towards substance abuse are highly correlated. *Objective:* This overview relies on a Medline research. Its objective is to describe the joint characteristics among ADHD and addiction. We especially focus on the neurobiological similarities between both diseases. *Results:* The results of this literature review support the hypothesis of a close genetic, neurological and phenotypic linkage between ADHD and addiction. Furthermore, ADHD often serves as the source for substance abuse disorders among youths and adults. *Conclusions:* The increasing clinical meaning of the overlap among ADHD and addiction urgently necessitates for consideration regarding preventive planning.

Keywords: **ADHD, Addiction, Substance use.**

Attention deficit hyperactivity disorder (ADHD) is a common, childhood-onset neurodevelopmental disorder with adverse consequences during adult life. It affects up to 10 % of children (1) and is associated with a wide range of impairments (2). The disorder is characterized by developmentally inappropriate levels of inattention, impulsivity or hyperactivity. ADHD may have a serious and harmful impact on a child's or adolescents psychosocial functioning. Adolescents with ADHD are far more likely to exhibit academic

underachievement, poor rapport and diminished self-esteem.

Substance disorder is a chronic, relapsing disorder in which compulsive drug-seeking and drug-taking behaviors persist despite serious negative consequences (3). The onset of substance use disorders usually begins in adolescence or early adulthood, mostly before the age of 20. The levels of drug use among youths under 14 are extremely low. Prevalence of cannabis use for example is 5.8% in the general United States population (4).

Already in 1986 coherence among addiction and ADHD has been suspected (5). Almost 8 years later the assumption has been approved in clinical research (6, 7). The strong interrelationship among ADHD and addiction was also shown by Biedermann in 1995 (8). This survey proved the high comorbidities among ADHD and addiction. The comparison of existing comorbidities within a clinical group of 120 patients with ADHD revealed 52% as drug addicted in comparison with 27% of the control group. Research on drug addiction shows a co-morbid prevalence of 50% in hyperkinetic disorder, whereas the prevalence in average population is about 5 % (9, 10). Recent studies likewise indicate an overrepresentation of ADHD in addicted adults. For example, studies of alcohol abusers yielded rates of 35% to 71% of adult alcoholics with childhood-onset and persistent ADHD (11). Including both, alcohol and drug addiction, 15% to 25% of adult addicts and alcoholics have current ADHD. For example, Schubiner et al. (12) found that 24% of 201 inpatients in a substance abuse treatment facility had ADHD, and that two thirds of them also had conduct disorder. The presence of ADHD also impacts the characteristics of cigarette smoking and substance use disorder (SUD). Adults with ADHD and SUD histories have been reported to have earlier onset of cigarette smoking and substance abuse compared with adults without ADHD (13). Additionally, more severe SUD has been reported in ADHD adults compared with adults without ADHD (14).

This overlap between ADHD and substance disorder has been an area of increasing clinical, research and public health interest. An important question is whether this is accidental, simply overlapping or the consequence of one another. New findings of genetic research are to be considered.

Family, twin and adoption studies show that genetic factors contribute to the etiology of ADHD and that environmental factors also play a role. These studies have shown the importance of genetic influences on continuity in ADHD over time and in accounting for the co-occurrence of ADHD and conduct disorder problems (15). In meta-analyses of molecular genetic studies the dopamine D4 gene and the D5 receptor gene have been found to be repeatedly associated with ADHD. This is proved already in earlier investigations: Many candidate gene studies of ADHD have produced substantial evidence implicating several genes in the etiology of the disorder. For the 8 genes for which the same variant has been studied in 3 or more case-control or family-based studies, 7 show statistically significant evidence of association with

ADHD based on pooled odds ratios across studies: The dopamine D4 receptor gene (DRD4), the dopamine D5 receptor gene (DRD5), and the dopamine transporter gene (DAT) (16). Recent research confirms these findings: significant heterogeneity was observed for the associations among ADHD and – for example - DAT1, DRD4, and DRD5 (17).

Twin, family, and adoption studies show that genetic factors play a significant role in vulnerability to becoming addicted to drugs (18). Drug addiction is a brain disease with complex genetic, psychological and social factors. The dopaminergic system of the brain plays a central role in natural reward and motivation and is the main neural substrate for the actions of abusive drugs. The dopaminergic and opioidergic reward pathways of the brain are crucial for survival since they provide the pleasure drives for eating, love and reproduction; these are called 'natural rewards' and involve the release of dopamine in the nucleus accumbens and frontal lobes. However, the same release of dopamine and production of sensations of pleasure can be produced by 'unnatural rewards' such as alcohol, cocaine, methamphetamine, heroin, nicotine, marijuana and other drugs, and by compulsive activities such as gambling, eating, sex, and risk taking behaviors. The analysis of mice with mutations in their dopamine receptor genes has provided new information regarding the influence of individual dopamine receptors on drug actions. (19). Dopamine transmission within cortical and subcortical structures is involved critically in the processing of emotionally relevant sensory information. Three interconnected neural regions, the medial prefrontal cortex, basolateral nucleus of the amygdala and the ventral tegmental area have received considerable experimental attention, both in animal and clinical research models, as essential interconnected processors of emotional information. Neuronal network disturbances in D (4)-receptor related neural circuitry may be involved in the neuropathological manifestations common in many neuropsychiatric disorders including schizophrenia, attention-deficit hyperactivity disorder and addiction (20). Studies have shown that in various subject groups parts of the DRD2 gene are associated with alcoholism, drug abuse, smoking, obesity, compulsive gambling, and several personality traits. (21). A recent review (22) indicates that different aspects of the addiction phenotype are critically influenced by dopaminergic receptors and that variants of those genes seem to influence some addiction phenotypes in humans.

This short overlook stresses the evidence of serious connections among ADHD and substance disorder. Further investigations of prevalence, genetic relations, and affinities will urgently be necessary to highlight enhanced prevention.

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