

## CLINICAL FEATURES

### COMORBIDITY OF ALCOHOL AND SUBSTANCE DEPENDENCE WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD)

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**Abstract — Aims:** Attention-deficit/hyperactivity disorder (ADHD) is of great clinical importance not only because of its high prevalence but also due to the frequent comorbid illnesses that are connected with this disorder. Several studies were able to demonstrate that ADHD constitutes a significant risk factor for the exacerbation of habit-forming illnesses, i.e. addictions. **Methods:** We conducted a study on 152 adult patients with alcohol dependence ( $n = 91$ ) or multiple substance addiction ( $n = 61$ ) to determine whether or not these patients were affected by ADHD. For retrospective assessment of childhood ADHD, the WURS-k was used as well as the DSM-IV symptom checklist for ADHD. The CAARS was used to assess the persisting symptoms of ADHD in adults. **Results:** 20.9% (WURS-k) or 23.1% (DSM-IV diagnostic criteria) of the alcohol-dependent patients showed evidence of retrospective ADHD affliction in childhood. With the help of CAARS, ADHD was proved to be persistent in 33.3% of the adult patients. In the group of substance-addicted patients 50.8% (WURS-k) and 54.1% (DSM-IV) presented with diagnostic criteria for ADHD in childhood and 65.5% (CAARS) showed evidence of ADHD persisting in adulthood. **Conclusions:** These results reveal that habit-forming illnesses can be associated with a high comorbidity with ADHD, expressed in the form of alcohol abuse and also in consumption of illegal drugs. The results underline the great importance of early and adequate diagnostics and therapy of ADHD for the prevention of habit-forming illnesses.

## INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is one of the most frequent afflictions experienced by children and, according to epidemiological studies, can be persistent and affect between 35% and 80% of adults with at least one or more symptoms of ADHD (Barkley, 1997). Wender (1995) describes a prevalence of ADHD in adulthood of 2%–6%. In a recent epidemiological study conducted in 2006, Kessler *et al.* found a prevalence of 4.4% among adults in the USA. The focal symptoms of this affliction include attention deficit, increased impulsiveness, hyperactivity, disorganization, and emotional instability stemming from childhood days (American Psychiatric Association, 1994).

Several studies have already demonstrated that ADHD, which nowadays is a term understood as a genetically determined dysfunction of the dopamine and noradrenergic catecholamine system (Ernst *et al.*, 1998; Faraone *et al.*, 1998; Dougherty *et al.*, 1999; Dresel *et al.*, 1999; Krause *et al.*, 2003), indeed represents a risk factor for the exacerbation of addictive illnesses. Wilens *et al.* (1997, 2004) and other authors (Goodwin *et al.*, 1975; Tarter *et al.*, 1977) found a comorbidity of ADHD and alcoholism or substance abuse in 35%–70%.

Patients with ADHD and drug addiction showed a tendency to commence early and to experiment more freely with substance abuse than those addicted patients without ADHD (Carroll and Rounsaville, 1993; Levin FR and Kleber, 1995; Wilens *et al.*, 1997; Biederman *et al.*, 1998). In a study conducted by Wilens *et al.* (1997), the average age of ADHD patients at onset

of substance abuse was found to be 19 years, whereas the addictive illness did not start on average until the age of 22 years in a control group of addictive patients without ADHD.

Other research groups have described a doubled lifetime risk of addictive illness for ADHD patients and concluded that ADHD in combination with a comorbid disorder (depression, anxiety disorder, etc.) additionally increases the risk of developing an addiction (Biederman *et al.*, 1995; Disney *et al.*, 1999). In this connection, it has also been reported that a personality disorder can be diagnosed in up to 71% of those with a comorbidity of ADHD and addictive illness (Schubiner *et al.*, 2000).

A high incidence of alcohol abuse in ADHD patients was found in several studies. For example, Biederman *et al.* (1998) described a markedly higher incidence of alcohol abuse or dependence among 239 adults with ADHD, at 44%, compared to a control population of 268 persons, 24% of whom were affected. In their investigation on 78 adult ADHD patients, Downey *et al.* (1997) determined an incidence of 33.3% for alcohol abuse or dependence. Rasmussen and Gilberg (2000) found an increased incidence of alcohol abuse in a controlled longitudinal study on 55 22-year-old patients, in whom ADHD had been diagnosed at the age of seven years and who had never received drug treatment, compared with 46 control subjects. Krause *et al.* (2002a) investigated 153 adult patients with alcohol dependence and found evidence of ADHD in childhood in 65 of them, 28 also showing persistent symptoms in adulthood.

With regard to cocaine dependence, it was shown that there is a prevalence of 35% in ADHD in combination with addictive illnesses and that the cocaine consumption is much more prominent and commences earlier in this patient group than in cocaine addicts without ADHD (Carroll and Rounsaville, 1993). Also, in studies conducted by Volkow *et al.* (2003), it was shown that there is more cocaine abuse in ADHD patients and that those affected report a marked reduction in symptoms after taking cocaine.

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The risk of nicotine dependence also appears to be higher in ADHD patients. The coincidence of nicotine dependence in adults with ADHD is reported as 40%–75% (Pomerleau *et al.*, 1995). In our own investigations, we were also able to demonstrate a markedly higher percentage of severe nicotine dependence in alcohol-dependent patients with comorbid ADHD than in patients without the additional diagnosis of ADHD (Ohlmeier *et al.*, 2007).

The studies available at present clearly show a connection between ADHD and addictive illnesses, which leads to the supposition that a high percentage of alcoholics and drug addicts are also suffering from a—possibly as yet undiagnosed—ADHD. The aim of this study was to examine retrospectively how many patients with alcohol and multiple substance dependence had in fact suffered ADHD in childhood and whether or not these symptoms persisted into adulthood. Furthermore, the question was raised as to the possible effects of ADHD with regard to commencement, type, and severity of addiction.

## SUBJECTS AND METHODS

152 patients were admitted to participate in this study (109 male and 42 female adults, one case missing) and all gave consent to undergo inpatient treatment in the Department for Addiction at a psychiatric institution (Klinikum Wahrendorff). The patients were taken consecutively into the study through 6 months. Diagnostic investigations were conducted for alcohol dependence syndrome (ICD F10.2; DSM-IV 303.90) and multiple substance dependence (ICD F19.2; DSM-IV 304.80). The European Addiction Severity Index (EuropASI) (Gsellhofer *et al.*, 1999) was used for evaluation of the addiction case history. The investigation was performed on patients with alcohol dependence at the earliest following a 10-day detoxification therapy and on those with multiple substance dependence at the earliest after a 14-day detoxification therapy. This time span was allocated to ensure that the patients were no longer

suffering from withdrawal symptoms. Exclusion criteria for participation in this study included acute psychosis and other illnesses that would exclude the approval ability of the patients. For retrospective assessment of childhood ADHD, the authorized German translation of the Wender Utah Rating Scale (WURS-k) (Retz-Junginger *et al.*, 2002) was used, as well as the DSM-IV symptom checklist for ADHD (American Psychiatric Association, 1994). Moreover, the individuals undergoing therapy were divided into diagnostic subgroups according to DSM-IV (inattentive type (DSM-IV 314.00), hyperactive-impulsive type (DSM-IV 314.01), combined type (DSM-IV 314.01)). The Conners Adult ADHD Rating Scales (CAARS, Long Version) (Conners *et al.*, 1999) were used to assess the persisting symptoms of ADHD in adults. Approval for this study was given by the Ethics Committee of Hanover Medical School.

### Statistical analysis

The  $\chi^2$  = test was performed for comparison of proportions. The Linear Trend Test was applied to test for a trend in ordinal categories. The unpaired *t*-test was used to compare means between two groups.

## RESULTS

According to DSM-IV, 91 (59.9%) of the 152 patients were diagnosed as alcohol-dependent and 61 (40.1%) as multiple substance-dependent. The group was composed of 109 male and 42 female (one case missing) patients with an average age of  $41.32 \pm 11.42$  years. The socio-demographic data of the participants are presented in Table 1.

As shown in Table 2, WURS-k demonstrated 19 patients (20.9%) in the group of alcohol-dependent individuals with a cutoff-score of  $\geq 30$ , thus giving evidence of ADHD in childhood. The DSM-IV symptom checklist confirmed likewise that 21 (23.1%) of the alcohol-dependent patients suffered ADHD

Table 1. Sociodemographic data of the investigated patients

	Alcohol dependence with ADHD (DSM-IV)	Alcohol dependence without ADHD (DSM-IV)	Total group—Alcohol dependence	<i>P</i> -value
Number of patients, <i>n</i> (%)	21 (23.1)	70 (76.9)	91 (100)	
Males/females, <i>n</i>	15/6	44/26	59/32	<i>P</i> = 0.471
Age (years), Mean $\pm$ SD	43.85 $\pm$ 9.32	47.80 $\pm$ 9.87	46.89 $\pm$ 9.84	<i>P</i> = 0.108
Final examinations, <i>n</i> (%)	0 (0)	9 (12.9)	9 (12.9)	<i>P</i> = 0.083
Graduation, <i>n</i> (%)	2 (9.5)	6 (8.6)	8 (8.8)	<i>P</i> = 0.892
Employed, <i>n</i> (%)	9 (45)	22 (31.4)	31 (34.4)	<i>P</i> = 0.260
Married, <i>n</i> (%)	4 (19.0)	25 (37.7)	29 (31.9)	<i>P</i> = 0.151
Divorced, <i>n</i> (%)	6 (28.6)	14 (20.0)	20 (22.0)	<i>P</i> = 0.405
	SUD with ADHD (DSM-IV)	SUD without ADHD (DSM-IV)	Total group SUD	<i>P</i> -value
Number of patients, <i>n</i> (%)	33 (54.1)	28 (45.9)	61 (100)	
Males/females, <i>n</i>	27/6	23/4	50/10	<i>P</i> = 0.728
Age (years), Mean $\pm$ SD	31.12 $\pm$ 6.98	35.25 $\pm$ 8.85	33.01 $\pm$ 8.10	<i>P</i> = 0.046
Final examinations, <i>n</i> (%)	3 (9.4)	4 (14.3)	7 (11.7)	<i>P</i> = 0.554
Graduation, <i>n</i> (%)	1 (3.1)	3 (10.7)	4 (6.7)	<i>P</i> = 0.240
Employed, <i>n</i> (%)	4 (12.9)	5 (17.9)	9 (15.3)	<i>P</i> = 0.597
Married, <i>n</i> (%)	4 (12.1)	6 (21.4)	10 (16.4)	<i>P</i> = 0.328
Divorced, <i>n</i> (%)	4 (12.1)	2 (7.1)	6 (9.8)	<i>P</i> = 0.515

Table 2. ADHD diagnosed with Wender Utah Rating Scale (WURS-k), DSM-IV symptom check-list for ADHD and Conners' Adult ADHD Rating Scales (CAARS)

	Alcohol-dependent patients ( <i>n</i> = 91)	SUD patients ( <i>n</i> = 61)	<i>P</i> -value
DSM-IV ADHD*, <i>n</i> (%)	21 (23.1)	33 (54.1)	<i>P</i> < 0.001
Inattentive type, <i>n</i> (%)	13 (14.3)	16 (26.2)	
Hyperactive-impulsive type, <i>n</i> (%)	2 (2.2)	3 (4.9)	<i>P</i> < 0.001
Combined type, <i>n</i> (%)	6 (6.6)	14 (23)	
WURS-k**, <i>n</i> (%)	19 (20.9)	31 (50.8)	<i>P</i> < 0.001
CAARS***, <i>n</i> (%), (DSM-IV ADHD pos, <i>n</i> = 21/ <i>n</i> = 33)	7 (33.3)	19 (65.5)	<i>P</i> = 0.080

\*DSM-IV ADHD = Diagnostic and Statistical Manual of Mental Disorders (a score higher than six in the first nine items indicates attentional problems; a score higher than six in the last nine items indicates hyperactivity).

\*\*WURS-k = The authorized German translation of the Wender Utah Rating Scale (WURS) indicates ADHD with a score of  $\geq 30$ .

\*\*\*CAARS = Conners' Adult ADHD Rating Scales (the analysis is conducted separately with respect to sex and age and gives an indication of the subject's current state).

in childhood. Seven (33.3%) of the DSM-IV assessed alcohol-dependent patients were found to have ADHD as a child and the CAARS also gave evidence of ADHD symptoms in childhood persisting then to adulthood.

In the group of patients with multiple substance dependence, WURS-k showed 33 (54.1%) patients with a cut off of  $\geq 30$ . The outcome of the retrospectively used DSM-IV symptom checklist showed that 33 (54.1%) patients had ADHD in their childhood. The CAARS gave evidence in this group of 19 (65.5%) patients with ADHD symptoms persisting to adulthood. The results of WURS-k, the DSM-IV symptom checklist and the CAARS of both groups of patients investigated are displayed side by side in Table 2.

Additionally, a diagnostic division of the ADHD subtypes was carried out according to the criteria of DSM-IV (Table 2). From the group of alcohol-dependent probands, 13 patients (14.3%) fulfilled the diagnostic criteria for "inattentive type", two patients (2.2%) the "hyperactive-impulsive type" and six patients (6.6%) the "combined type". In contrast to this, the group of substance-dependent probands revealed 16 patients (26.2%) to fulfill the diagnostic criteria for "inattentive type", three patients (4.9%) the "hyperactive-impulsive type," and 14 (23%) the "combined type" (*P* = 0.001).

Regarding the type of substance abuse, it was determined that those patients with ADHD (diagnostic criteria of DSM-IV) consumed a higher quantity of cocaine (75.8% versus 71.4%; *P* = 0.775) and considerably more cannabis (97.0% versus 85.7%; *P* = 0.170). Also, the consumption of heroin was markedly higher in the ADHD group (84.8% versus 67.9%;

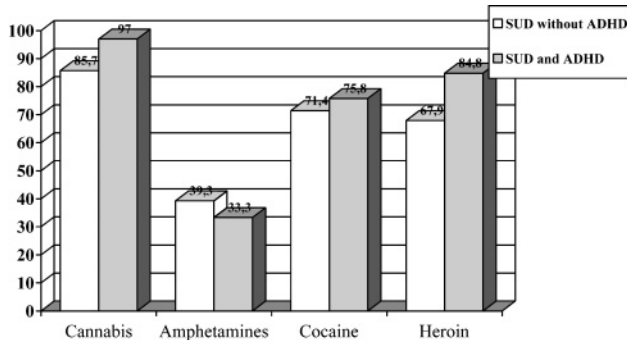


Fig. 1. Type of drug abuse in percent (group of drug dependents *n* = 61)

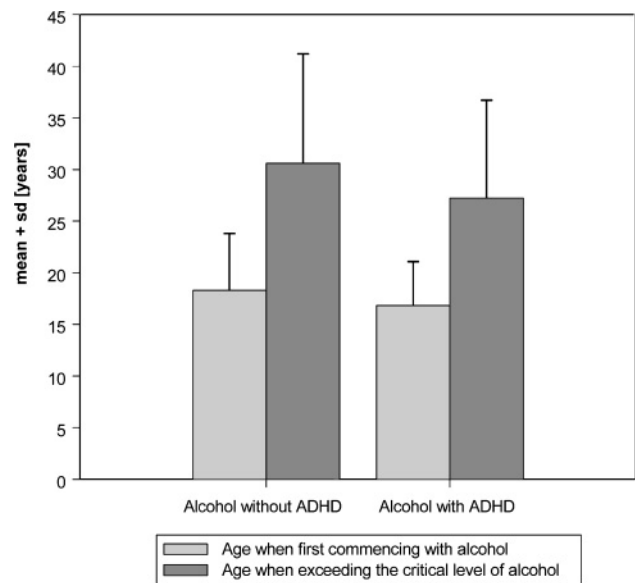


Fig. 2. Age when first commencing with alcohol and first experience exceeding the critical level of alcohol consumption in alcohol-dependent patients (*n* = 91) with and without comorbid ADHD.

*P* = 0.138); however, the use of amphetamines was found to be somewhat lower (33.3% versus 39.3%; *P* = 0.790) (Figure 1). However, there do not exist significant differences in both groups.

It was evident from both groups of probands that substance abuse was commenced much earlier by those patients with ADHD. Figures 2 and 3 demonstrate the starting age of alcohol and substance abuse in those multiple substance-dependent patients with and without comorbid illness.

## DISCUSSION

The results of the present study show that the patients of a large department treating substance abuse disproportionately frequently also fulfill the diagnostic criteria of DSM-IV for the presence of ADHD. In the group of alcohol dependents and—more markedly—in the group of patients with multiple substance addiction, a high percentage of them could be diagnosed

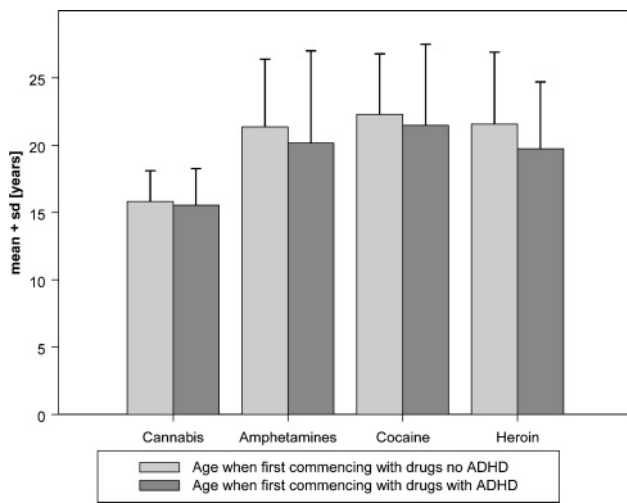


Fig. 3. Age when first commencing with drugs in drug-dependent patients ( $n = 61$ ) with and without comorbid ADHD.

retrospectively as having suffered from ADHD in childhood, in part persisting into adulthood. In both groups, a significantly lower age of first consumption of alcohol and drugs was observed when ADHD was present. Our study results thus suggest that ADHD can be considered to be an important risk factor for the development of addiction, on the one hand, and for “early first consumption”, on the other.

The present study results thus appear to be of particular importance in terms of preventive medicine. Several investigations have shown that the treatment of children suffering from ADHD with methylphenidate (MPH) reduces the risk of later substance abuse (Biederman *et al.*, 1999; Huss 1999). In a long-term study over 5 years, considerably less use of addictive substances was observed in patients with ADHD who had received therapy with MPH than in untreated ADHD patients (Loney 1988). Adolescent ADHD patients who were treated with stimulants thus appear to have a lower risk of developing an addiction (alcohol, cocaine, and other drugs) and engage in less substance use (Biederman *et al.*, 1999). On the other hand, various studies have demonstrated that the treatment of ADHD patients suffering from addictive illnesses with stimulants reduces their substance abuse and craving (Levin *et al.*, 1998a, 1998b; Riggs *et al.*, 1998). Under therapy with MPH, reduced cocaine craving and an improvement in ADHD symptoms was described in ADHD patients engaging in cocaine abuse (Levin *et al.*, 1998b; Schubiner *et al.*, 2002).

There are several reasons why there is such a high coincidence of ADHD and addictive illnesses. Firstly, it is fairly evident that the “hyperactive-impulsive” and “combined type” patients are of a more experimentative and reckless nature when it comes to drugs and alcohol—this explains the higher consumption of “high-risk drugs” such as heroin. Our investigation revealed significantly higher values in the group of substance-dependent patients for the “inattentive type” and the “combined type.” The isolated “hyperactive-impulsive type” patients in both groups were, in comparison, underrepresented. The higher representation in the substance-dependent group and the high number of “combined type” patients—subsuming the criteria for inattention and hyperactivity-impulsivity—

give reason to suppose that this group is more likely subjected to rash actions. Patients of an “inattentive type” seem to be more likely to use the substance primarily for stimulation.

Another reason for the high coincidence of ADHD and addictive illnesses might be considered to be the unsuccessful attempt at self-treatment. Biederman *et al.* (1995) reported that the drug most commonly used by ADHD patients was cannabis, a long way ahead of amphetamines, cocaine and hallucinogens, only then followed by opioids, which do not appear to belong to the preferred drugs of ADHD sufferers. The clinical findings show that the affected patients reported a so-called improvement in the ADHD-specific symptoms when applying “self-medication” in the form of cannabis and cocaine. Correspondingly, the presented results give evidence of a markedly higher consumption of cannabis and at least a tendency towards a higher intake of cocaine in the ADHD group. The “self-treatment” hypothesis is also supported by studies conducted by Volkow *et al.* (2003) that reported a marked reduction in ADHD symptoms after cocaine consumption. It may be assumed that the intake of cocaine leads postsynaptically to an increase in dopamine concentration, which provides a relief from ADHD symptoms.

Pathophysiologically, the high prevalence of addictive illnesses in ADHD might thus be explained by the fact that these substances stimulate the release of neurotransmitters—especially of dopamine—thus reducing the core symptoms of ADHD. Studies regarding the nicotine consumption of ADHD patients support this hypothesis. Nicotine appears to have a similar effect on the nucleus accumbens to that of amphetamine derivatives (Pontieri *et al.*, 1996). In another study, a comparable effect of nicotine on dopamine transporters could be demonstrated, as is known for methylphenidate (Krause *et al.*, 2002b). In contrast, the consumption of alcohol appears to have a rather suppressant effect on ADHD patients. On the basis of clinical observations, affected patients report a somewhat calming effect after alcohol consumption, which also often leads to an improvement in the insomnia they often experience.

## CONCLUSION

Clinical experience and the results of the study presented indicate that it may be assumed that addictive illnesses with a high comorbidity are indeed connected with ADHD. This may be expressed in the form of alcohol dependence or in the consumption of illegal drugs. This underlines the great importance of timely and adequate diagnostics and therapy of ADHD in order to prevent the onset of addictive illnesses.

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