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To cite this article: Ylva Holst & Lisa B. Thorell (2019): Functional impairments among adults with ADHD: A comparison with adults with other psychiatric disorders and links to executive deficits, Applied Neuropsychology: Adult, DOI: [10.1080/23279095.2018.1532429](https://doi.org/10.1080/23279095.2018.1532429)

To link to this article: <https://doi.org/10.1080/23279095.2018.1532429>



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Published online: 09 Jan 2019.



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Functional impairments among adults with ADHD: A comparison with adults with other psychiatric disorders and links to executive deficits

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ABSTRACT

The aim of the present study was to investigate daily life functioning in adults with ADHD and adults with other psychiatric disorders and to compare ADHD subgroups with or without executive deficits. Daily life functioning was assessed using self-ratings covering the following domains: academic/occupational functioning, social relations, daily life problems, and criminality. Executive deficits were assessed using self-ratings and laboratory tests of working memory, inhibition, and shifting. The results showed that adults with ADHD were more impaired with regard to academic functioning, current occupational status, daily life functioning, criminality, and some aspects of social functioning. The ADHD subgroup with executive deficits had more impairments than the subgroup without executive deficits with regard to academic functioning, current occupational status, and criminality. Conclusively, ADHD in adulthood is related to significant impairment in many areas of daily functioning, also compared to patients with other psychiatric disorders. Executive functioning deficits appear to at least partly explain these impairments.

KEYWORDS

ADHD; executive deficits; academic functioning; occupational functioning; social relations; criminality

Introduction

Attention deficit/hyperactivity disorder (ADHD; American Psychiatric Association, 2013) is a psychiatric disorder characterized by inattention, hyperactivity, and impulsivity. Previously, ADHD was primarily diagnosed in children, but it has become evident that these symptoms are relatively common also among adults, with prevalence estimates most often ranging from 2% to 5% (reviews by Fayyad et al., 2007; Kooij et al., 2010).

However, we still know a relatively minimal amount regarding functional impairments in daily life associated with adult ADHD, at least as compared to those of adults with other psychiatric disorders. Furthermore, we need to identify factors that can explain why some individuals with ADHD have severe problems with daily life functioning, whereas others function relatively well. The overall aim of the present study was therefore to examine functional impairments in daily life (i.e., social relations, daily life problems, criminality, as well as academic and occupational functioning) in adults with ADHD as compared to those of adults with other psychiatric disorders. In addition, we aimed to investigate the link between neuropsychological deficits and

functional impairments in daily life in adults with ADHD.

Functional impairments among individuals with ADHD and other psychiatric disorders

Previous studies have concluded that adults with ADHD have impairments in major life activities. More specifically, it is well known that, compared to adults without psychiatric problems, adults with ADHD often experience academic underachievement (see review by Arnold, Hodgkins, Kahle, Madhoo, & Kewley, *in press*), unemployment, and problems in work performance (e.g., Biederman et al., 2006a; Biederman et al., 2006b; Biederman et al., 2012; Frazier, Youngstrom, Glutting, & Watkins, 2007; Gjervan, Torgersen, Nordahl, & Rasmussen, 2012; Voigt et al., 2017). These problems have a substantial economic impact as a result of the absenteeism and lost productivity seen among adults with ADHD (for a review see Küpper et al., 2012). In addition to academic and work-related problems, adults with ADHD also often experience social and interpersonal difficulties (Biederman et al., 1993; Eakin et al., 2004; Wilens & Dodson, 2004).

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They are also more likely than controls to have unstable relationships and marital difficulties, resulting in higher rates of separation and divorce (e.g., Barkley, 2002; Biederman et al., 1993; Weiss & Murray, 2003). A third area of concern in adult ADHD is antisocial and criminal behavior. Compared to normal controls, individuals with ADHD in childhood have been shown to be at a two- to threefold increased risk of being arrested, convicted, or incarcerated in adulthood (for a review see Mohr-Jensen & Steinhausen, 2016), and higher rates of antisocial personality disorder have also been found (e.g., Storebø & Simonsen, 2016). When investigating adult ADHD, a previous study showed that 40% of long-term adult inmates in prisons have ADHD (Ginsberg, Hirvikoski, & Lindfors, 2010), and criminal behavior has been found in more than 50% of clinic-referred adults with ADHD (Soendergaard et al., 2015).

Conclusively, previous studies have established that adults with ADHD have impairments in several areas of functioning relative to healthy controls, but few studies have compared adults with ADHD to adults with other psychiatric disorders. However, Barkley and colleagues found that, compared to individuals with other types of psychiatric problems, adults with ADHD had poorer educational results, more impaired work performance, had more often been fired/dismissed from a job, and had higher levels of substance use, anti-social behavior, and criminal acts (Barkley, Murphy, & Fischer, 2008; Murphy & Barkley, 1996; Barkley & Murphy, 2010). Although the major aim of the study by Potvin and colleagues was to examine objective and subjective measures of cognition in two clinical samples, they also examined daily life functioning (Potvin, Charbonneau, Juster, Purdon, & Tourjman, 2016). Results demonstrated that the healthy controls had better daily life functioning compared to patients with either ADHD or major depression, but the two clinical groups did not differ significantly. In the present study, we aimed to provide additional information on daily life functioning in adults with ADHD by comparing them to a clinical control group of adults with mood and anxiety disorders (56%) or other psychiatric disorders such as bipolar disorder, phobias, or personality disorders.

Link between functional impairments and executive deficits

Although ADHD is associated with functional impairments in several areas of daily life, as described above, there are also individuals with the disorder who

function relatively well. It should therefore be considered important to investigate to what extent underlying neuropsychological deficits can explain these differences. One of the most central neuropsychological deficits that has been shown to be associated with ADHD is executive functioning (EF) deficits (e.g., reviews by Barkley, 2014; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). EF is commonly defined as cognitive processes that are necessary for maintaining an appropriate problem-solving-set in order to reach future goals (Welsh & Pennington, 1988). In line with the thinking that ADHD is associated with executive dysfunction, previous research has shown that adults diagnosed with ADHD differ from healthy controls with regard to executive functions such as working memory, inhibition, switching, and planning (e.g., Alderson, Kasper, Hudec, & Patros, 2013; Boonstra, Kooij, Oosterlaan, Sergeant, & Buitelaar, 2010; Rohlf et al., 2012). A few previous studies have also shown significant differences in EF deficits when comparing adults with ADHD to adults with other psychiatric disorders, but the results are inconsistent, with significant differences only being found for some domains or even some specific tasks (e.g., Holst & Thorell, 2017; Walker, Shores, Trollor, Lee, & Sachdev, 2000). In addition, it has been demonstrated that when using person-oriented analyses (i.e., calculating the proportion of patients with ADHD who are considered impaired), a substantial subgroup of adults with ADHD does not display any neuropsychological deficits (Halleland, Sörensen, Posserud, Haavik, & Lundervold, in press; Thorell et al., 2017). An important question is therefore to what extent the heterogeneity found with regard to neuropsychological deficits among patients with ADHD can explain why this patient group also shows great variation with regard to how well they function in daily life.

The few previous studies examining the link between neuropsychological functioning and functional impairments in adult ADHD have shown that, compared to the subgroup without EF deficits, the ADHD subgroup with EF deficits has a significantly higher frequency of problems with academic achievement and occupational functioning (Biederman et al., 2006a; Halleland et al., in press), as well as criminality, traffic accidents, and social functioning in many areas of daily life. In studies investigating neuropsychological deficits as a dimension (i.e., from low to high deficits) rather than as a category, poorer executive functioning has been shown to be related to higher levels of unemployment (Barkley & Fischer, 2011; Barkley & Murphy, 2010), as well as to

antisocial behavior and criminality among adults with ADHD (Barkley & Murphy, 2011).

Another interesting finding from investigations of the link between neuropsychological deficits and daily life functioning is that relations have been shown to be much stronger when neuropsychological deficits are studied using EF self-ratings rather than EF tests (Barkley & Fischer, 2011; Barkley & Murphy, 2010; Potvin et al., 2016). When interpreting this finding, it is important to take the strengths and limitations of different methods into account. As repeatedly shown in previous research, the relation between tests and ratings is typically small, which could be taken to indicate that these methods capture at least partly different constructs (cf. Toplak, West, & Stanovich, 2013). Ratings capture average behavior over an extended period of time, but are limited in that they are influenced by rater biases, and they usually capture global behavior rather than specific deficits. In many ratings of executive functioning, items that are almost identical to the symptom criteria for ADHD are included (cf. Thorell & Nyberg, 2008). Laboratory tests, on the other hand, capture optimal performance on specific functions in a highly structured situation and there is therefore reason to question to what extent they actually capture deficits in daily life. To address this issue, the present study applied a multiple method approach, including both ratings and laboratory tests.

Aims

The overall aim of the study was to investigate functional impairments in adults with ADHD compared to those in adults with other psychiatric disorders. More specifically, we aimed to address the following research questions: a) Do adults with ADHD differ from a clinical control group (i.e., primarily patients with anxiety and/or depression) regarding social relations, daily life functioning, criminality, as well as academic and occupational functioning; b) Do ADHD subgroups with or without EF deficits differ from one another with regard to the functional impairments associated with the disorder?

Method

Participants and procedure

The present study included a total of 95 younger adults (age range 18–45 years) from two groups: a clinical group of adults with ADHD ($n=50$, 40% men); and a clinical group of adults diagnosed with other psychiatric disorders ($n=45$, 29% men). The

participants were recruited through advertisements at three outpatient psychiatric clinics, and they visited the clinic on two occasions to perform the neuropsychological testing. All participants completed a full psychiatric assessment conducted by a licensed psychologist. For the ADHD group, the assessment included a clinical judgment using the second version of the Diagnostic Interview for ADHD in Adults (DIVA 2.0; Kooij & Francken, 2010). This semi-structured interview consists of two parts: one for assessing the presence of all 18 criteria in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) during childhood and in the present; the other for assessing impairment in five areas of functioning (i.e., education, work, family, social/relationships, and self-confidence) in childhood and in the present. In addition, current levels of ADHD symptoms were assessed using self-report on the Adult ADHD Self-Report Scale (ASRS-v1.1; Kessler et al., 2005). The psychologist also interviewed a close relative of the participant, in most cases his/her mother, to obtain a detailed anamnesis. All participants in the ADHD group, but none of the participants in the clinical control group, met the full diagnostic criteria according to the DSM-5 (American Psychiatric Association, 2013). All participants underwent testing of global intellectual ability using the fourth edition of the Wechsler Adult Intelligence Scale (WAIS-IV; Wechsler, 2008) and exclusion criteria were an IQ score of <80 on WAIS-IV and the presence of substance-related disorders. With regard to medication, 34 (68%) of the patients with ADHD were on stimulant medication. No other types of ADHD-medications were used. Patients were asked to withdraw medication at least 24 hours before testing.

A majority of the patients in the clinical control group had mood and/or anxiety disorders, but we also included patients with other psychiatric disorders (except for ADHD) such as bipolar disorder, social phobia, or personality disorders (see Table 1 for details). The diagnostic procedure included the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998), which was complemented with one or several standardized rating instruments, depending on the identified symptoms. All clinical controls took part in the study at the time of receiving their diagnosis, which means that none of them were in remission and none of them had started receiving pharmacological or behavioral treatment.

With regard to ethical concerns, the study was approved by the local ethics committee at the

Karolinska Institute, Stockholm (2011/266-31/4) and it was carried out in accordance with the Declaration of Helsinki. Informed written consent was obtained for all participants and they were informed that they could withdraw from the study at any time without providing a reason for doing so.

Measures

Ratings of functional impairments

Self-ratings assessing functional impairment were completed either at home or at the clinic. The following sections list the domains that were included.

Academic functioning

For this domain of functioning, we used self-ratings of grade point average, grade retention, whether the participant had ever received special educational support in school, and highest obtained educational level.

Occupational functioning

For this domain of functioning, we used self-ratings of number of months in unemployment, number of months on sickness benefit (for sick leaves longer than one month), and current occupational status (i.e., working/studying, unemployed, or sickness benefit).

Social functioning

We assessed the participants' number of social relations using four questions ("How many close friends do you have," "How many times/month do you have contact with your friends through e-mail, meetings, or phone calls," "How many times/month do friends or family members visit you in your home" and "How many times/month do you meet your friends in your spare time"). Ratings were made on a 4-point scale (less than one, 1–2, 3–4, 5 or more). We also assessed the quality of their relationships with friends and family. The question asked was the following: "During the past six months, how well have you gotten along with your brothers/sisters/father/mother/partner/children/friends." Ratings were made on a scale from 0 (no contact at all) to 5 (very well). We combined some of the ratings to obtain measures of quality of relationships with family (i.e., mother, father, siblings, and children) and used two separate scores for the quality of relationships with partner and friends.

Daily life functioning

We used the ADHD Daily Problem Questionnaire (ADPQ; Thorell, Sjöwall, Mies, & Scheres, 2017) to assess daily life functioning in several areas. The

ADPQ is similar in design to Barkley's Functional Impairment Scale (BFIS; Barkley, 2011b), in that it contains a list of daily activities, and participants (or a close relative/friend of the patient) are asked to rate their level of functioning on a scale from 0 ("no problem") to 9 ("very severe problem"). However, whereas the BFIS contains relatively broad items (e.g., problems "in your home life with your immediate family"), the ADPQ contains more specific items within four problem areas: (1) economic problems (2 items: e.g., "handling money in a responsible way"), (2) daily chores/responsibilities (4 items: e.g., "cleaning," "doing laundry,"), (3) time management (4 items: "keeping appointments"), and (4) social relations (2 items: e.g., "going to a party when I do not know the other guests well"). The reason for focusing on these four areas is that previous research has shown that the most serious impairments among individuals with ADHD are found in these areas (e.g., Barkley et al., 2008).

Criminality

In order to measure criminal behavior, the patients were presented with a list of 15 criminal acts and asked to rate their own behavior on a 5-point scale (0 = never, 1 = 1 time, 2 = 2–3 times, 3 = 4–10 times, 5 = more than 10 times). The list included the following areas: (1) violent criminal behavior (e.g., physical abuse), (2) nonviolent criminal behavior (e.g., shoplifting, pickpocketing), and 3) driving-related problems (e.g., driving without a license, speeding). In the present study, we used the mean value for all fifteen items as a measure of criminality. In addition, we asked the participant whether he/she had ever been arrested by the police.

Laboratory measures of executive deficits

All of the tests of EF deficits used in the present study were selected from either the Delis Kaplan Executive System (D-KEFS; Delis, Kaplan, & Kramer, 2001) or WAIS-IV (Wechsler, 2008). A major advantage of using subtests from these two internationally well-known test batteries was that age- and gender-adjusted scaled scores are available. This allowed us to categorize our ADHD participants into those with and without EF deficits (see further description of how the groups were defined under the heading "statistical analyses"). We provide a detailed description of all included measures in the following sections.

Verbal working memory was measured by two subtests from WAIS-IV: the Letter-Number Sequencing Task and the Digit Span Task. In the

Letter-Number Sequencing Task, participants are asked to repeat a series of randomly mixed letters and numbers, starting with the numbers in ascending order, followed by the letters in alphabetical order. In the Digit Span Task, the participants have to repeat a series of numbers backwards (Digit Span Backwards) or in the correct numerical order (Digit Span Sequencing). The Digit Span Forward was not included, as this test primarily measures short-term memory rather than working memory.

Inhibition was measured using the third trial (interference trial) of the Color Word subtest from D-KEFS. In this task, the participants are presented rows of words printed in dissonant colors and are instructed to inhibit reading the words and instead name the dissonant colors in which the words are printed. The number of seconds needed to complete the trial was used as a measure of inhibition.

Set shifting was measured using the shifting trials from both the Color Word Task and the Verbal Fluency Task from D-KEFS. During the shifting condition of the Color Word Task, the participants are asked to switch back and forth between naming the dissonant colors and reading the words. Completion time was used as a measure of set shifting. In the shifting condition of the Verbal Fluency Task, participants are instructed to alternate between saying words from two different semantic categories as quickly as possible for 60 seconds. Number of correct shifts was used as a second measure of set shifting.

Planning was measured by the Tower test from D-KEFS. The participants are instructed to build towers with disks (varying in size) in the fewest number of moves possible using pre-specified rules. The Total Achievement Score, which is the mean of three measures (i.e., number of moves to completion, the item-completion time, and correct number of towers), was used as a measure of planning.

Ratings of neuropsychological deficits

Executive functioning

The Adult Executive Functioning Inventory (ADEXI; Holst & Thorell, 2018) was used to investigate executive functioning. The ADEXI is a 14-item questionnaire measuring working memory (e.g., "I have difficulty remembering lengthy instructions") and inhibition (e.g., "I have a tendency to do things without first thinking about what could happen"). This instrument has proven to have good psychometric properties and has been shown to discriminate well between adults with ADHD and controls (Holst &

Thorell, 2018). The ADEXI is an adult version of the Childhood Executive Functioning Inventory (CHEXI; Thorell & Nyberg, 2008; Thorell, Eninger, Brocki & Bohlin, 2010), and both the child and adult version are freely available for both clinicians and researchers in several languages (see www.chexi.se).

Statistical analysis

First, we checked the data for outliers using the outlier labeling rule (Hoaglin & Iglewicz, 1987), but no outliers were detected. Second, group differences between the ADHD group with executive deficits, the ADHD group without executive deficits, and the clinical control group were conducted using one-way Analysis of Variances (ANOVAs) for the dimensional measures and chi-square analyses for the categorical measures. Post-hoc analyses (i.e., paired comparisons) were used in which the following group differences were examined: (1) ADHD group (with and without executive deficits) versus the clinical controls and (2) ADHD patients with versus those without executive deficits. In accordance with the respective manuals for D-KEFS (Delis et al., 2001) and WAIS-IV (Wechsler, 2008), performance on each test was categorized as being average/above average (scaled score ≥ 8) or impaired (scaled score ≤ 7 ; i.e., ≥ 1 SD below the mean) relative to available norms. Based on previous research (e.g., Biederman et al., 2006a), we defined individuals as having deficits in executive functioning if they had an impaired score on two or more of the neuropsychological tests. Effect sizes for the dimensional variables were investigated using Cohen's d , and the size of the effects was interpreted in line with recommendations, where .30 is considered a small effect, .50 a medium effect, and .80 a large effect (Cohen, 1988). Effect sizes for the categorical variables were investigated using Phi (ϕ), and the size of the effects was interpreted in line with recommendations, where .10 is considered a small effect, .30 a medium effect, and .50 a large effect (Cohen, 1988). Analyses similar to those conducted for the laboratory measures could not be made for the ADEXI self-ratings as almost all ADHD participants (86%) were classified as having EF deficits if using the same cut-off as used for the tests (i.e., ≥ 1 SD below the mean). Instead, we used the median split to divide the ADHD group into those with low and high executive functioning. Thereafter, t-tests or chi-square tests were used to examine possible differences in functional impairments between patients with and without EF deficits. Similar to the other analyses, effects sizes were

calculated using Cohen's d for the dimensional variables and Phi (ϕ) for the categorical variables.

We did not include IQ as a covariate in our analyses as it has been repeatedly argued (e.g., Barkley, 2014; Dennis et al., 2009) that such practice is misguided and generally unjustified in research on neurodevelopmental disorders such as ADHD. The reason for this is that controlling for IQ is likely to eliminate variance that is a result of ADHD in the measures under scrutiny.

Results

In total, 30 patients with ADHD (60%) were classified as having EF deficits according to the definition that they had an impaired score (≥ 1 SD below the mean) on at least two measures. The mean number of impaired measures for patients with EF deficits was 3.33 ($SD = 1.30$).

Descriptive data and group differences for the background variables are presented in Table 1. There was no main effect of age, $F = 1.17$, or sex, $\chi^2 = 1.29$, and post hoc comparisons did not show any significant difference between either (1) ADHD and clinical controls or (2) ADHD subgroups with and without EF deficits. However, there was a trend towards a significant group difference with regard to general intelligence as measured by the General Ability Index (GAI) from WAIS-IV (Wechsler, 2008), $F = 2.59$, $p < .10$. Post hoc comparisons revealed that the subgroup with executive deficits had significantly lower scores on GAI compared to the ADHD subgroup without executive deficits, $t = 2.39$, $p < .05$. As expected, there were also significant main effects of both symptoms of inattention and hyperactivity/impulsivity, both

$F > 13.22$, $ps < .001$, although the ADHD subgroup with and without EF deficits did not differ significantly with regard to ADHD symptom levels, both $ts = .32$. ADHD patients with and without EF deficits groups did not differ with regard to the proportion who were on stimulant medication, $\chi^2 = .01$, or with regard to the presence of comorbid disorders, all $\chi^2 < .95$. Finally, the three groups did not differ with regard to total number of diagnoses, $F = .31$, ns.

Group differences between the ADHD group and the clinical controls

The results of the group comparisons for all main study variables are presented in Table 2. With regard to academic functioning, adults with ADHD had significantly more problems compared to the clinical control group for all included measures (i.e., grade point average, grade retention, educational support, and educational level). As for occupational functioning, no significant differences were found between adults with ADHD and the clinical control group regarding previous months of unemployment or sick leave. However, a significant difference was found regarding current occupational status. The proportion of individuals working or studying was similar. However, the ADHD group and the clinical control group differed significantly regarding the rate of unemployment and sickness benefit. Among the adults with ADHD, the rate of unemployment was low, whereas the rate for sickness benefit was high, especially in the ADHD subgroup with EF deficits. The clinical control group, on the other hand, had a lower rate of patients on sickness benefits, but a higher proportion of unemployed patients.

Table 1. Descriptive data for background variables, ADHD symptom levels, comorbid diagnoses, and general intellectual functioning.

	ADHD with EFD ($n = 30$)			ADHD without EFD ($n = 20$)			Clinical Control Group ($n = 45$)		
	<i>M</i>	(<i>SD</i>)	%	<i>M</i>	(<i>SD</i>)	%	<i>M</i>	(<i>SD</i>)	%
Background variables									
Age (years)	26.60	(5.90)		27.95	(6.25)		25.71	(4.80)	
Gender (% men)			40			40			29
General Ability Index (GAI)	92.47	(11.26)		101.84	(16.17)		96.31	(14.60)	
Stimulant medication for ADHD			37			35			0
ADHD symptom levels									
Hyperactivity/impulsivity	22.20	(6.70)		22.80	(5.93)		15.29	(7.06)	
Inattention	25.20	(5.07)		25.40	(4.76)		16.93	(7.17)	
Comorbid diagnoses (%)									
Mood disorders (incl. depression)			20			20			67
Anxiety disorders			3			10			24
Bipolar disorder			7			10			16
Personality disorders			7			5			11
Panic disorder			7			0			2
Obsessive Compulsive Disorder			3			0			7
Eating Disorder			0			5			2
Social phobia			0			0			9
Total number of diagnoses	1.40	(0.62)		1.40	(0.60)		1.36	(0.54)	

Table 2. Means and standard deviations (dimensional variables) or percentages (categorical variables), as well as group comparisons for functional impairments.

	ADHD with EFD (n = 30)		ADHD without EFD (n = 20)		Clinical Control Group (n = 45)		F/χ^2	Paired comparisons (effect size)		
	M	(SD)	%	M	(SD)	%		ADHD vs. Controls	ADHD with vs. without EFD	
Academic functioning										
Grade point average	8.85	(5.46)		11.56	(5.92)		13.58 (5.45)	5.78**	2.96** (.64)	1.59 (.48)
Grade retention			30			5	7	9.91**	3.65* (.19)	4.69* (.31)
Special educational support			70			40	24	15.37***	10.94*** (.34)	4.43* (.30)
Educational level								23.49***	15.44*** (.40)	7.82* (.40)
Lowest level (≤ 9 years)			50			20				4
Medium level (10-12 years)			50			65				82
University/college			0			15				14
Occupational functioning										
Unemployment (months)	6.97	(13.31)		7.28	(11.16)		9.33 (12.66)	0.34	0.83 (.18)	0.08 (.03)
Sick leave (months)	14.56	(24.60)		11.26	(20.81)		12.93 (31.04)	0.08	0.05 (.01)	0.48 (.14)
Current occupational status										
Working			27			55			0.06 (.02)	4.09* (.29)
Studying			27			25			< 0.01 (.01)	0.02 (.02)
Unemployed			7			5			5.28* (.24)	0.06 (.03)
Sick pay/sickness benefit			40			15			2.78 + (.17)	3.85* (.28)
Social functioning										
Number of social contacts	2.54	(0.76)		3.00	(0.83)		3.10 (0.81)	4.52*	2.16* (.64)	0.13 (.58)
Quality of social contact - family	2.96	(1.08)		3.35	(1.06)		3.60 (1.06)	2.80*	2.00* (.46)	2.04* (.36)
Quality of social contact - friends	3.61	(1.10)		4.16	(1.30)		3.80 (1.57)	0.91	0.20 (.02)	1.26 (.46)
Quality of social contact - partner	3.95	(1.16)		4.46	(0.78)		4.00 (1.11)	1.06	0.57 (.15)	1.56 (.50)
Daily life problems										
Problems with time management	4.59	(2.20)		4.15	(2.80)		3.05 (2.25)	4.18*	2.83** (.58)	0.62 (.18)
Problems with money management	4.57	(2.66)		3.28	(2.88)		3.14 (2.15)	3.21*	1.76 + (.36)	1.63 (.47)
Problems with social relations	4.53	(2.95)		3.05	(2.77)		3.01 (2.16)	3.57*	1.74 + (.36)	1.78 + (.51)
Problems completing daily chores	3.73	(2.06)		3.54	(1.97)		2.50 (1.98)	3.99**	2.82** (.58)	.34 (.09)
Criminality										
Criminality Total	2.30	(0.99)		1.78	(0.61)		1.48 (0.52)	11.32***	3.95*** (.80)	2.08* (.60)
Arrested by the police			63			40	27	10.01**	7.31** (.28)	2.63* (.23)

Note. The table only shows results for when groupings (i.e. with versus without EF deficits) are based on the laboratory measures.
 $+p < .10$. $*p < .05$. $**p < .01$. $***p < .001$.

For social functioning, adults with ADHD had a significantly lower number of social contacts, and a poorer quality of social contacts with family members compared to the clinical control group. For daily life problems, adults with ADHD had more problems on all measures (i.e., problems with time management, money, social relations, and doing chores), although the effects were marginally significant (i.e., $p < .10$) for money management and social relations. For criminality, adults with ADHD reported a significantly larger number of criminal acts compared to the clinical controls. Moreover, a larger proportion of adults with ADHD compared to controls had been arrested by the police. As shown in Table 2, effect sizes were generally shown to be medium for the significant effects and small for the non-significant effects. The exception was number of criminal acts, for which a large effect size was found.

Group differences between ADHD patients with and without executive deficits

As described in the method section under the heading “statistical analyses,” we categorized the ADHD group

into those with and without EF deficits in order to determine whether these subgroups differed with regard to functional impairments. This categorization was done separately for the laboratory tests and for the self-ratings.

Laboratory test of EF deficits

When grouping the ADHD patients based on laboratory measures, the results showed that when comparing ADHD patients with and without EF deficits with regard to academic functioning, the ADHD subgroup with EF deficits reported significantly more often that they had repeated a grade. They had also more often received special educational support. In addition, the ADHD subgroup with EF deficits reported a significantly lower educational level compared to ADHD patients without EF deficits, with none of the adults in the ADHD subgroup with EF deficits reported having a university/college degree. The size of these significant effects was large. The ADHD subgroups with and without EF deficits did not differ significantly with regard to grade point average, although the effect size was large enough to approach a medium size ($g = .48$).

With regard to occupational functioning, the ADHD subgroup with EF deficits were less often working and more often on sickness benefits compared to ADHD patients without EF deficits. Effect sizes for these significant effects were both of about medium size. With regard to social functioning and daily life problems, few significant differences were found between the ADHD subgroups with and without EF deficits, but most of the effect sizes were of medium size or slightly below. The exception was quality with regard to social contact with family members, for which ADHD patients with EF deficits reported significantly poorer quality. For criminality, the ADHD subgroup with EF deficits reported a significantly larger number of criminal acts and a larger proportion had been arrested by the police, compared to the subgroup without EF deficits. Effects sizes for criminality were of medium size.

Self-ratings of EF deficits

With regard to the self-ratings of executive functioning using the ADEXI (not shown in Table 2), the results showed that few significant differences were found between ADHD patients with low versus high levels of executive functioning. More specifically, no significant differences were found for educational functioning ($t = .43$ and all $\chi^2 < 1.81$), occupational functioning (all $t_s < .34$ and $\chi^2 = 3.43$), social functioning (all $t_s < 1.57$), or criminality (all $t = .29$ and $\chi^2 = .11$). The effect sizes for these non-significant effects were all small. With regard to daily life problems, patients with high executive deficits were found to have significantly larger problems with time management, social relations, and completing daily chores compared to ADHD patients with low executive deficits (all $t_s > 2.38$, $p < .05$), but no significant difference was found for money management, $t = 1.14$. Effect sizes for the significant effects were of medium size ($g_s > .68$), but small for nonsignificant effect, $g = .27$.

Discussion

In this study, we aimed to investigate functional impairments in adults with ADHD compared to those in adults with other psychiatric disorders. A second aim was to compare subgroups of ADHD patients with and without EF deficits with regard to functional impairments. The results showed that adults with ADHD had greater problems with social relations, daily life functioning, and academic functioning. Concerning occupational functioning, the groups did

not differ with regard to previous number of months in unemployment or on sickness benefits. However, differences were found in current occupational status: Adults with ADHD were more often on sickness benefit and less often unemployed compared to adults in the clinical control group. With regard to the comparison between ADHD patients with and without EF deficits, the results showed that the groups differed primarily with regard to academic functioning, current occupational status, and criminality. The other effects were not significant, but the effect sizes were in the medium range for several measures within the domain of both social relations and daily life problems.

Academic and occupational functioning

For academic functioning, our finding of significant impairment among patients with ADHD is in line with previous studies comparing an ADHD group with healthy controls (see review by Arnold et al., [in press](#)), and our study adds important knowledge by showing that individuals with ADHD are more impaired in academic functioning than are patients with other psychiatric disorders. Our results also indicate that executive deficits play a role in explaining these differences, as the ADHD subgroup with EF deficits was shown to be more impaired than those without EF deficits. Although few previous studies of adults have made similar comparisons, our findings are in line with two earlier studies showing that ADHD patients with and without EF deficits differ with regard to academic functioning (Biederman et al., 2006a; Halleland et al., [in press](#)). In addition, childhood studies have demonstrated that EF deficits mediate the link between ADHD and academic achievement (e.g., Sjöwall & Thorell, 2014) and that early EF deficits are related to later academic achievement (e.g., Biederman et al., 2004; Sjöwall, Bohlin, Rydell, & Thorell, 2017). Thus, previous research has demonstrated a link between academic achievement and executive functioning, especially in childhood, and the present results support this link.

With regard to occupational functioning, the proportion of participants who were working was 38% for the total ADHD group. This result is very similar to that found in a previous American study, which showed that only 34% of adults patients with ADHD were employed fulltime (Biederman et al., 2006b). Thus, adults with ADHD clearly have a much lower rate of employment compared to healthy controls, and the present study also show that this rate is similar to that found for patients with other psychiatric

diagnoses (i.e., 36%). In addition, the present study adds two new important findings. First, the ADHD subgroup with EF deficits had significantly higher rates of sickness benefit compared to the subgroup without EF deficits. Another interesting and important finding of the present study is that a large percentage (40%) of patients in the ADHD group with EF deficits were currently on sickness benefit, whereas the proportion that were unemployed was relatively low (7%). A different pattern of results was found for the clinical control group, which had a high rate of unemployment (22%) and a somewhat lower rate of individuals receiving sickness benefits (16%). This finding indicates that many individuals with ADHD had such serious impairment in daily life functioning that they were considered unable to work. These high rates of occupational difficulties are one important reason why adult ADHD has been shown to be associated with high societal costs (e.g., Matza, Paramore, & Prasad, 2005).

Social relations and daily life problems

The present findings as well as results from previous studies are consistent in showing that adults with ADHD often have problems with social relations (e.g., Biederman et al., 1993; Biederman et al., 2006b; Eakin et al., 2004; Fayyad et al., 2007; Sobanski et al., 2007). This could have serious consequences, because having meaningful relationships with one's family, partner, and friends enriches life. We often make new acquaintances at school or at work. Due to the high rate of unemployment or sickness benefit among adults with ADHD, these individuals may not have the same opportunities to meet new people and make friends. With regard to the quality of social relations rather than the number of relations, "family relations" was the only area for which we found a significant difference between the ADHD group and controls. This may be related to the fact that ADHD is a highly heritable disorder (e.g., Larsson, Chang, D'onofrio, & Lichtenstein, 2014), and adults with ADHD therefore often have siblings and/or parents with the same disorder, possibly making intra-familial relations particularly complicated. Because the present study included a relatively young sample, with a substantial group younger than 25 years of age, we did not include rates of divorce or separation. However, previous studies have shown that adults with ADHD have fewer partnerships and more divorces (for a review see Rösler, Casas, Konofal, & Buitelaar, 2010; Sobanski et al., 2007).

Compared to the adults in the clinical control group, adults with ADHD had more problems in their daily life, especially with regard to time management and completing daily chores. Significant effects at the level of tendency were also found for problems with money management and social relations. These results are in line with, for example, the International Classification of Functioning (ICF) Core sets for ADHD (de Schipper et al., 2015; Mahdi et al., 2017), in which carrying out daily routines and interpersonal relations are presented as two of the most common activities that individuals with ADHD have difficulties with. In the present study, we show that adults with ADHD have more severe daily life problems than do clinical controls. Concerning the influence of executive deficits on daily life problems, results from the present study are mixed. Whereas no significant differences were found for daily life problems when classifying individuals based on EF laboratory tests, several differences were found between those with high versus low EF deficits based on self-ratings. This finding is in line with the results presented by Barkley and colleagues, who showed that daily life functioning was more strongly related to EF ratings than to EF tests (Barkley & Fischer, 2011; Barkley & Murphy, 2010). To what extent these differences are related to rater bias or shared method variance is discussed in the following sections (see heading "EF tests versus EF ratings").

Criminality

For criminality, we found significant group differences, with large effect sizes, when comparing the ADHD group and controls with regard to both number of criminal acts and the proportion having been arrested by the police. It has been argued that the development of criminality among adults with ADHD is primarily due to childhood conduct disorder or substance use disorders (e.g., Von Polier, Vloet, & Herpertz-Dahlmann, 2012). It is therefore interesting to note that the present study found large differences in criminality between ADHD and clinical controls, despite the fact that ongoing substance abuse was an exclusion criterion. Also, none of the participants in the ADHD group had been diagnosed with antisocial personality disorder in adulthood, although we lack information regarding participants' levels of conduct problems during childhood. Other studies have discussed the importance of EF deficits in adult criminality. In a study by Ginsberg et al. (2010), long-term inmates were shown to have poorer working memory

compared to controls. This is in line with the present study, as we also showed that the ADHD subgroup with EF deficits had significantly higher levels of criminal behavior and a higher proportion had been arrested by the police, compared to the ADHD subgroup without EF deficits.

EF tests versus EF ratings

Thus far, the discussion has mainly been focused on the results when using EF laboratory tests. However, an important issue to discuss is how EF deficits should best be assessed. As described in the introduction, laboratory tests and ratings have different strengths and limitations and appear to capture at least partly different constructs (Toplak et al., 2013). More specifically, previous research has shown that the link between neuropsychological deficits and daily functioning is much stronger for EF ratings than for EF tests (Barkley & Fischer, 2011; Barkley & Murphy, 2010; Potvin et al., 2016), a finding that has been interpreted as support for the low ecological validity of EF tests. However, the present results did not demonstrate particularly clear differences between those with and without EF deficits when using ratings, except for differences in daily life problems. These differences in results can at least partly be attributed to differences in the rating instrument used to measure EF deficits. The Barkley Deficits in Executive Function Scale (BDEFS; Barkley, 2011a) and the Behavior Rating Inventory of Executive Functions – Adult version (BRIEF-A; Roth, Isquith, & Gioia, 2005), two of the most well-known instruments for assessing EF deficits in adults, both include items that assess everyday functioning that might be a result of EF deficits rather than assessing EF deficits directly (e.g., “Unable to work as well as others without supervision or frequent instructions,” “have difficulties managing my money or credit cards,” “Other people tell me that I am lazy or unmotivated”). In addition, these instruments include items measuring symptoms of ADHD (e.g., “makes decisions impulsively” or “I have problems sitting still”). Another important issue is that the use of ratings to investigate both EF deficits and functional impairments is likely to lead to overestimation of the relation due to shared method variance.

In summary, we would like to argue that previous studies using solely ratings might have overestimated the role of EF deficits as a major component for understanding variations in functional impairments among individuals with ADHD. An interesting finding from the present study is that, when basing the

ADHD subgroups on EF tests, group differences were found in relation to more objective measures like educational level, grade retention, and occupational status. When basing the ADHD subgroups on ratings, group differences were only found for a few subjective ratings of daily life problems. We believe that this provides a further indication of rater bias in EF ratings. When interpreting these results, it is important to remember that a more stringent cut-off criterion for impairment was used for the EF ratings as almost all patients (86%) would have been classified as impaired if using the same cut-off as used for EF tests. However, despite the fact that the subgrouping based on EF ratings identified a more severe subgroup relative to the controls, fewer significant group differences in daily life functioning were found between those with and without EF deficits. The finding that a larger percentage of ADHD patients are classified as impaired based on EF ratings compared to EF tests, even when using the same cut-off criterion, is in line with previous research on children (Sjöwall & Thorell, *in press*). The present study contributes with new knowledge by showing that when using a rating instrument that captures EF deficits specifically (which most previous studies have not done), the relation between EF deficits and daily life functioning is relatively weak. In our opinion, the results of the present study should be interpreted as additional support for the notion that EF tests and EF ratings capture at least partly different constructs rather than as support that one type of method is necessarily better than the other. An important issue for future research is therefore to determine how information about EF deficits collected from multiple sources should best be combined in order to get a more complete picture of a patient's strengths and difficulties.

Limitations, future directions, and conclusions

The present study is limited by its small sample size, especially concerning the comparison between ADHD patients with and without EF deficits. However, because only a limited number of previous studies on adult ADHD have compared these two ADHD subgroups with regard to functional impairment, the present study adds valuable new information. That said, it would be of value for future research to investigate whether the present results could be replicated using a larger sample, preferably large enough to enable several different neuropsychological subgroups to be identified. Previous research has demonstrated that ADHD is not only related to EF deficits, but also to

deficits in delay aversion, reaction time variability, and emotion regulation (e.g., Holst & Thorell, 2017; Shaw, Stringaris, Nigg, & Lebenluft, 2014). For this reason, a broader range of functions is important, as is longitudinal follow-ups to investigate to what extent the ADHD subgroup with EF deficits is at higher risk of persistence with regard to ADHD symptom severity as well as how EF deficits are related to daily life functioning over time. With regard to prediction over time, it should also be of interest to examine how to best combine data from EF tests and EF ratings. Within the present study, 17 (34%) of the adults with ADHD had EF impairment with regard to both ratings and tests, 13 (26%) had impairments with regard to tests only, 10 (20%) had impairments with regard to ratings only. Thus, it was not possible to use a single versus double dose approach, but this should be considered an important avenue for future research.

It should also be noted that age could be an important factor in the relation investigated within the present study. As shown in a meta-analysis (Pievsky & McGrath, 2017), group differences between ADHD and controls show a U-shaped distribution with the strongest group differences being found in childhood (age 8–16) and middle adulthood (age 30 and above). It will therefore be important for future research to examine to what extent our findings can be generalized to either younger or older samples.

In conclusion, the present study demonstrates that daily life functioning is severely affected among adults diagnosed with ADHD, as they are significantly more impaired even compared to adults with other psychiatric disorders. The present study also shows that EF deficits appear to play a role in explaining these impairments, although primarily with regard to academic functioning, occupational status, and criminality. There is some previous research showing improved academic performance after computerized training of executive functioning, although results vary greatly with regard to type of program and how the outcome measure is assessed (Titz & Karbach, 2014). If future research were to demonstrate that executive functioning can be improved through training, this may be an important intervention, although it will be crucial to establish that effects are not only short-term and that they can be generalized to daily functioning. Due to the many areas of impairment for adults with ADHD and the fact that such a large percentage are unemployed or on sickness benefit, it is also necessary, in many cases, to make appropriate adjustments in the work setting for these individuals. Adamou et al. (2013) presented several such adjustments, most of

which are neither expensive nor time-consuming, although they concluded that these adjustments are seldom implemented. As reported in autobiographies and blog posts with titles such as “How I turn my ADHD into a superpower,” as well as in scientific studies emphasizing energy and creativity as strengths of ADHD (e.g., Mahdi et al., 2017), there are also positive traits associated with ADHD. We have concluded that even though ADHD in adulthood is clearly related to severe impairment, it is important to attempt to identify individual strengths to minimize the negative effects of the disorder on daily life functioning.

Acknowledgments

The authors wish to thank Tobias Johansson for valuable help with the data collection.

Disclosure statement

The authors declare that they have no potential conflict of interest to report in relation to this work.

References

- Adamou, M., Arif, M., Asherson, P., Aw, T.-C., Bolea, B., Coghil, D..., Young, S. (2013). Occupational issues of adults with ADHD. *BMC Psychiatry*, 13, 59.
- Alderson, R. M., Kasper, L. J., Hudec, K. L., & Patros, C. H. (2013). Attention deficit/hyperactivity disorder (ADHD) and working memory in adults: a meta-analytic review. *Neuropsychology*, 27(3), 287–302.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington D.C.: American Psychiatric Association.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington D.C.: American Psychiatric Association.
- Arnold, E., Hodgkins, P., Kahle, J., Madhoo, M., & Kewley, G. (in press). Long-term outcomes of ADHD: Academic achievement and performance. *Journal of Attention Disorders*, 1–13. Advance online publication. DOI: [10.1177/1087054714566076](https://doi.org/10.1177/1087054714566076).
- Barkley, R. A. (2002). Major life activity and health outcomes associated in attention-deficit/hyperactivity disorder. *Journal of Clinical Psychiatry*, 63(Suppl 12), 10–15.
- Barkley, R. A. (2011a). *Barkley Deficit in Executive Functioning Scale (BDEFS)*. New York, NY: Guilford Press.
- Barkley, R. A. (2011b). *Barkley Functional Impairment Scale (BFIS)*. New York, NY: Guilford Press.
- Barkley, R. A. (2014). *Attention-deficit Hyperactivity Disorder: A handbook for diagnosis and treatment* (4th Ed.). New York: Guilford Publications.
- Barkley, R. A., & Fischer, M. (2011). Predicting impairment in major life activities and occupational functioning in hyperactive children as adults: self-reported executive function (EF) deficits versus EF tests. *Developmental Neuropsychology*, 36(2), 137–161.

- Barkley, R. A., & Murphy, K. R. (2010). Impairment in occupational functioning and adult ADHD: the predictive utility of executive function (EF) ratings versus EF tests. *Archives of Clinical Neuropsychology*, *25*, 157–173.
- Barkley, R. A., & Murphy, K. R. (2011). The nature of executive function (EF) deficits in daily life activities in adults with ADHD and their relationship to EF tests. *Journal of Psychopathological Behavior Assessment*, *33*(2), 137–158.
- Barkley, R. A., Murphy, K. R., & Fischer, M. (2008). *ADHD in adults: What the science says*. New York: Guilford Press.
- Biederman, J., Faraone, S. V., Spencer, T. J., Mick, E., Monuteaux, M. C., & Aleardi, M. (2006b). Functional impairment in adults with self-reports of diagnosed ADHD: A controlled study of 1001 adults in the Community. *Journal of Clinical Psychiatry*, *67*(4), 524–540.
- Biederman, J., Faraone, S. V., Spencer, T. J., Wilens, T., Norman, D., Lapey, K. A..., Doyle, A. E. (1993). Patterns of psychiatric comorbidities, cognition, and psychosocial functioning in adults with attention deficit hyperactivity disorder. *American Journal of Psychiatry*, *150*(12), 1792–1798.
- Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., & Ferrero, F. (2004). Impact of executive function deficits and attention-deficit/hyperactivity disorder on academic outcomes in children. *Journal of Consulting and Clinical Psychology*, *72*(5), 757–766.
- Biederman, J., Petty, C. R., Fried, R., Fontanella, J., Doyle, A. E., Seidner, L., & Faraone, S. V. (2006a). Impact of psychometrically defined deficits of executive functioning in adults with attention deficit hyperactivity disorder. *American Journal of Psychiatry*, *163*(10), 1730–1738.
- Biederman, J., Petty, C. R., Woodworth, K. Y., Lomedico, A., Hyder, L. L., & Faraone, S. V. (2012). Adult outcome of attention-deficit/hyperactivity disorder: A controlled 16-year Follow-Up study. *Journal of Clinical Psychiatry*, *73*(7), 941–950.
- Boonstra, A. M., Kooij, J. J. S., Oosterlaan, J., Sergeant, J. A., & Buitelaar, J. K. (2010). To act or not to act, that's the problem: Primarily Inhibition Difficulties in Adult ADHD. *Neuropsychology*, *24*, 209–221.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd edn). Hillsdale, NJ: Erlbaum.
- de Schipper, E., Mahdi, S., Coghill, D., de Vries, P. J., Shur-Fen Gau, S., Granlund, M..., Bölte, S. (2015). Towards an ICF core set for ADHD: a worldwide expert survey on ability and disability. *European Child and Adolescent Psychiatry*, *24*(12), 1509–1521.
- Delis, D., Kaplan, E., & Kramer, J. (2001). *Delis-kaplan executive function system*. San Antonio, Texas: The Psychological Corporation.
- Dennis, M., Francis, D. J., Cirino, P. T., Schachar, R., Barnes, M. A., & Fletcher, J. M. (2009). Why IQ is not a covariate in cognitive studies of neurodevelopmental disorders. *Journal of the International Neuropsychological Society*, *15*, 331–343
- Eakin, L., Minde, K., Hechtman, E., Krane, O. E., Bouffard, R., Greenfield, B ..., Looper, K. (2004). The Marital and family functioning of adults with ADHD and their spouses. *Journal of Attention Disorders*, *8*(1), 1–10.
- Fayyad, J., De Graaf, R., Kessler, R., Alonso, J., Angermeyer, M., Demyttenaere, K..., Jin, R. (2007). Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *British Journal of Psychiatry*, *190*(5), 402–409.
- Frazier, T. W., Youngstrom, E. A., Glutting, J. J., & Watkins, M. W. (2007). ADHD and achievement: Meta-analysis of the Child, Adolescent, and Adult literatures and a Concomitant Study with College Students. *Learning Disabilities*, *40*(1), 49–65.
- Ginsberg, Y., Hirvikoski, T., & Lindfors, N. (2010). Attention Deficit Hyperactivity Disorder (ADHD) among longer-term prison inmates is a prevalent, persistent and disabling disorder. *BMC Psychiatry*, *10*, 112.
- Gjervan, B., Torgersen, T., Nordahl, H. M., & Rasmussen, K. (2012). Functional Impairment and Occupational Outcome in Adults with ADHD. *Journal of Attention Disorders*. *16*(7), 544–552.
- Halleland, H. B., Sörensen, L., Posserud, M. -B., Haavik, J., & Lundervold, A. (in press). Occupational status is compromised in adults with ADHD and psychometrically defined executive function deficits. *Journal of Attention Disorders*. Advance online publication. DOI: [10.1177/1087054714564622](https://doi.org/10.1177/1087054714564622).
- Hoaglin D. C., & Iglewicz, B (1987). Fine tuning some resistant rules of outlier labeling. *Journal of American Statistical Assessment*. *82*, 1147–1149.
- Holst Y., & Thorell L. B. (2017). Neuropsychological functioning in adults with ADHD and adults with other psychiatric disorders: The issue of specificity. *Journal of Attention Disorders*, *21*, 137–148.
- Holst, Y., & Thorell, L. B. (2018). Adult Executive Functioning Inventory (ADEXI): Validity, Reliability, and relations to ADHD. *International Journal of Methods in Psychiatric Research*, *27*:e1567
- Kessler, R. C., Adler, I., Ames, M., Demler, O., Faraone, S. V., Hirpi, E..., Walters, E. E. (2005). The World Health Organization Adult ADHD Self-report Scale (ASRS): a short screening scale for use in the general population. *Psychological Medicine*, *35*(2), 245–256.
- Kooij, J. J. S., Bejerot, S., Blackwell, A., Caci, H., Casas-Brugué, M., Carpentier, P. J. ..., Asherson, P. (2010). European consensus statement on diagnosis and treatment of adult ADHD: The European Network Adult ADHD. *BMC Psychiatry*, *10*, 67.
- Kooij, J. J. S., & Francken, M. H. (2010). *Diagnostic Interview for ADHD in Adults 2.0 (DIVA 2.0). Adult ADHD. Diagnostic Assessment and Treatment*. Amsterdam: Pearson Assessment and Information BV.
- Küpper, T., Haavik, J., Drexler, H., Ramos-Quiroga, J. A., Wermelskirchen, D., Prutz, C., & Schauble, B. (2012). The negative impact of attention deficit/hyperactivity disorder on occupational health in adolescents and adults. *International Archives of Occupational and Environmental Health*, *85*(8), 837–847.
- Larsson, H., Chang, Z., D'onofrio, B. M., & Lichtenstein, P. (2014). The heritability of clinically diagnosed attention-deficit hyperactivity disorder across the lifespan. *Psychological Medicine*, *44*(10), 2223–2229.
- Mahdi, S., Viljoen, M., Massuti, R., Selb, M., Almodayfer, O., Karande, S..., Bölte, S. (2017). An international qualitative study of ability and disability in ADHD using

- the WHO-ICF framework. *European Child and Adolescent Psychiatry*, 10, 1219–1231
- Matza, L. S., Paramore, C., & Prasad, M. (2005). A review of the economic burden of ADHD. *Cost Effectiveness and Resource Allocation*, 3(5). doi:10.1186/1478-7547-3-5
- Mohr-Jensen, C., & Steinhausen, H. C. (2016). A meta-analysis and systematic review of the risks associated with childhood attention-deficit hyperactivity disorder on long-term outcome of arrests, convictions, and incarcerations. *Clinical Psychological Review*, 48, 32–42.
- Murphy, K. R. & Barkley, R. A. (1996). Attention deficit hyperactivity disorder adults: Comorbidities and adaptive impairments. *Comprehensive Psychiatry*, 37(6), 393–401.
- Pievsky, M. A. & McGrath, R. E. (2017). The neurocognitive profile of attention-deficit/hyperactivity disorder: A review of meta-analyses. *Archives of Clinical Neuropsychology*, 33, 143–157
- Potvin, S., Charbonneau, G., Juster, R. -P., Purdon, S., & Tourjman, S. V. (2016). Self-evaluation and objective assessment of cognition in major depression and attention deficit disorder: Implications for clinical practice. *Comprehensive Psychiatry*, 70, 53–64.
- Rohlf, H., Jucksch, V., Gawrilow, C., Huss M., Hein, J., Lehmkuhl, U., & Salbach-Andrae, H. (2012). Set shifting and working memory in Adults with attention-deficit/hyperactivity disorder. *Journal of Neural Transmission*, 119(1), 95–106.
- Rösler, M., Casas, M., Konofal, E., & Buitelaar, J. (2010). Attention deficit hyperactivity disorder in adults. *The World Journal of Biological Psychiatry*, 11(5), 684–698.
- Roth, R. M., Isquith, P. K., & Gioia, G. A. (2005). Behavior rating inventory of executive function - adult version (BRIEF-A). Lutz, FL: Psychological Assessment Resources.
- Shaw, P., Stringaris, A., Nigg, J., & Lebenluft, E. (2014). Emotion dysregulation in attention deficit hyperactivity disorder. *American Journal of Psychiatry*, 171(3), 276–293.
- Sheehan, D. V., Lecrubier, Y., Harnett-Sheehan, K., Janvas, J., Weiller, E., Bonara, L. I. ..., Dunbar, G. C. (1998). The Mini International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic interview. *Journal of Clinical Psychiatry*. 59(Suppl 20), 22–33.
- Sjöwall, D., Bohlin, G., Rydell, A. M., & Thorell, L. B. (2017). Neuropsychological deficits in preschool as predictors of ADHD symptoms and academic achievement in late adolescence. *Child Neuropsychology*, 23(1), 111–128.
- Sjöwall, D. & Thorell, L.B. (in press), A critical appraisal of the role of neuropsychological deficits in preschool ADHD, *Child Neuropsychology*
- Sjöwall, D., & Thorell, L. B. (2014). Functional Impairments in attention deficit hyperactivity disorder: The mediating role of neuropsychological functioning. *Developmental Neuropsychology*, 39(3), 187–204.
- Sobanski, E., Brüggemann, D., Alm, B., Kern, S., Deschner, M., Schubert, T..., Rietschel, M. (2007). Psychiatric comorbidity and functional impairment in a clinically referred sample of adults with attention-deficit/hyperactivity disorder (ADHD). *European Archive of Psychiatry and Clinical Neuroscience*, 257(7), 371–377.
- Soendergaard, H. M., Thomsen, P. H., Pedersen, P., Pedersen, E., Elkjaer Poulsen, A., Nielsen, J. M. ..., Soegaard, H. J. (2015). Education, occupation, and risk-taking behaviours among adults with attention-deficit/hyperactivity Disorder. *Danish Medical Journal*, 62(3), 1–6.
- Storebø, O. J., & Simonsen, E. (2016). The Association between ADHD and Antisocial Personality Disorder (ASPD): A Review. *Journal of Attention Disorders*, 20(10), 815–824.
- Thorell, L. B., Holst, Y., Christiansen, H., Kooij, J. J. S., Bejlunga, D., & Sjöwall, D. (2017). Neuropsychological deficits in adults age 60 and above with attention deficit hyperactivity disorder. *European Psychiatry*, 45, 90–96.
- Thorell, L. B., & Nyberg, L. (2008). The childhood executive functioning inventory (CHEXI): A new rating instrument for parents and teachers. *Developmental Psychology*, 33(4), 536–552.
- Thorell, L.B., Sjöwall, D., Mies, G.W., & Scheres, A. (2017). Quick delay questionnaire: Psychometric properties, relations to functional impairments and discrimination between adults with ADHD and both clinical and non-clinical controls. *Psychological Assessment*, 10, 1261–1272.
- Thorell, L. B., Eninger, L., Brocki, K. C., & Bohlin, G. (2010). Childhood Executive Function Inventory (CHEXI): A Promising Measure for Identifying Young Children with ADHD? *Journal of Clinical and Experimental Neuropsychology*, 32, 38–43.
- Titz, C., & Karbach, J. (2014). Working memory and executive functions: effects of training on academic achievement. *Psychological Research*, 78(6), 852–868.
- Toplak, M. E., West, R. F., & Stanovich, K. E. (2013). Practitioner Review: Do performance-based measures and ratings of executive functions assess the same construct? *Journal of Child Psychology and Psychiatry*, 54(2), 131–143.
- Voigt, R. G., Katusik, S. K., Colligan, R. C., Killian, J. M., Weaver, A. L., & Barbaresi, W. J. (2017). Academic achievement in adults with a history of childhood attention deficit/hyperactivity disorder: A population-based prospective study. *Journal of Developmental and Behavioral Pediatrics*. 38(1), 1–11.
- Von Polier, G. G., Vloet, D.T., & Herpertz-Dahlmann, B. (2012). ADHD and Delinquency: A developmental perspective. *Behavioral Sciences and the Law*, 30(2), 121–139.
- Walker, A. J., Shores, E. A., Trollor, J. N., Lee, T., & Sachdev, P. S. (2000). Neuropsychological functioning of adults with attention deficit hyperactivity disorder. *Journal of Clinical and Experimental Neuropsychology*, 22(1), 115–124.
- Wechsler, D. (2008). *Wechsler adult intelligence scale* (4th ed.). San Antonio, Texas: The Psychological Corporation.
- Weiss, M., & Murray, C. (2003). Assessment and management attention-deficit hyperactivity disorder in adults. *Canadian Medical Association Journal*, 168(6), 715–722.
- Welsh, M. C., & Pennington, B. F. (1988). Assessing frontal lobe functioning in children: Views from developmental psychology. *Developmental Neuropsychology*, 4, 199–230.
- Wilens, T. E., & Dodson, W. (2004). A clinical perspective of attention-deficit/hyperactivity disorder into adulthood. *Journal of Clinical Psychiatry*, 65(10), 1301–1313.
- Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, 57, 1336–1346.