

Struggling with ADHD in adulthood
A study of patients in a private clinic

by

Espen Anker

Medical doctor, private practitioner, specialist in psychiatry

Dissertation for the degree of Doctor Philosophiae

(Doctor philos)

Faculty of Medicine

University of Oslo

2022

© Espen Anker, 2023

*Series of dissertations submitted to the
Faculty of Medicine, University of Oslo*

ISBN 978-82-348-0232-4

All rights reserved. No part of this publication may be reproduced or transmitted, in any form or by any means, without permission.

Cover: UiO.

Print production: Graphic Center, University of Oslo.

Acknowledgments

As newly educated psychiatrist, in 2005, I started diagnosing and treating adults with psychiatric difficulties in a private practice in Oslo. Questions about ADHD and its comorbidities quickly arose. Having people with ADHD in my family gave me first-hand experience in the importance of adequate assessment and treatment of the disorder. Over the following years, my patients taught me about the variety and complexity of the ADHD disorder, and the severe personal cost of being undiagnosed and untreated. I thank this lovely patient group for sharing, discussing, supporting, and giving me material for research, and for writing this dissertation. Treating people with ADHD to enable better functioning has been a privilege.

I thank my beautiful wife, best friend, best colleague, and child psychiatrist Bothild Bendiksen, who did her PhD work on ADHD, ODD, and CD in preschool children (Bendiksen, 2016), and encouraged me to implement a measure of emotional dysregulation for assessment of adult ADHD. She has been my best co-supervisor, answering all questions, day or night.

I thank Professor Jan Haavik, my co-supervisor in Bergen, for providing insightful answers to difficult ADHD questions and leading me on a sustainable track towards publishing ADHD articles.

The difficulties in conducting research in a private psychiatric outpatient clinic by myself, rather than a PhD program or even a University Hospital, appeared insurmountable, but, through a small scholarship from the Norwegian Medical Association, I gained confidence in my project. I was on a path as a researcher and was hoping to find a supervisor when, by luck, I met psychiatrist and Professor Trond Heir, who was willing to guide me through this research project. I thank Trond, particularly for providing tremendous and priceless help with my research project, my articles, my doubts and confusion, and my lack of research knowledge, as well as for sharing his expertise with me. Without Trond, I would never have been able to publish these five papers and deliver this dissertation.

I thank my co-authors, Anne Halmøy, Ylva Ginsberg, and Geir Øgrim, for support in specific articles, ADHD Norge for guiding patients to seek advice from me, Nev.Som. for two scholarships, and the Norwegian Medical Association for financially supporting this dissertation.

I also thank my wonderful and loving children, Mathilda and Johannes, for reminding me about humanity, normality, and talent, and for being patient with their working father.

Espen Anker, Oslo, January 2022

Table of Contents	page:
Acknowledgments	3
Table of content	5
Summary	7
<i>Norsk sammendrag</i>	9
List of Papers - publication included in this dissertation	11
Abbreviations	12
1. INTRODUCTION	13
1.1 Attention Deficit Hyperactive Disorder - ADHD	13
Table 1.: ADHD adult Self- Rating Scale (ASRS)	14
1.2 Assessment and treatment of ADHD	15
1.3 Participants consenting to provide statistic material for this dissertation	15
1.4 Emotional Dysregulation	16
1.5 Emotional dysregulation in this dissertation	19
Table 2.: Deficient Emotional Self Rating (DESR) questionnaire	21
1.6 Psychiatric Comorbidity	22
1.7 Work participation	22
1.8 Drug use Disorder	23
1.9 Criminal Conviction	24
1.10 WAIS measures – verbal working memory and processing speed	25
2. AIMS OF THE STUDY	29
3. MATERIAL AND METHOD	31
3.1 Study Design	31
3.2 Procedure	31
3.3 Participants	31
3.4 Measures	32
3.4.1 Demographic factors	32
3.4.2 ADHD severity	32
3.4.3 Emotional dysregulation	32
3.4.4 Psychiatric comorbidity	33
3.4.5 WAIS - Working memory and processing speed	33
3.5 Data analysis	34
3.6 Ethical considerations	35
4. SUMARY OF RESULTS	37
4.1 General results of the study	37
4.2 Results of psychiatric comorbidity	37
4.3 Results of work participation	38
4.4 Results of substance use disorder	39
4.5 Results of criminal conviction	40
4.6 Results of WAIS with working memory and processing speed	40

5. DISCUSSION	43
5.1 Gender differences in the presentation of ADHD and emotional dysregulation	43
5.2 Discussion of psychiatric comorbidity	43
5.3 Discussion of work participation	45
5.4 Discussion of substance use disorders	47
5.5 Discussion of criminal conviction	49
5.6 Discussion of WAIS test – verbal working memory and processing speed	51
5.7 Methodological discussion	55
5.8 Clinical implications	56
5.9 Conclusions	59
6. FUTURE PERSPECTIVES	61
6.1 Investigation of more associations	61
6.2 Longitudinal studies after treatment of ADHD	61
6.3 Future perspectives on ADHD aspects and neuropsychological measures	62
6.4 Future perspectives on emotional dysregulation in ADHD	62
Table 3. ADHD Emotional Dysregulation Questionnaire (proposal)	64
6.5 Psychotherapy of emotional dysregulation	65
7. REFERENCES	67

Appendix:

1. **Paper I**
2. **Paper II**
3. **Paper III**
4. **Paper IV**
5. **Paper V**

Summary

This dissertation focuses on adults diagnosed with attention deficit hyperactivity disorder (ADHD). The study was conducted in a private psychiatric outpatient clinic in Oslo, where 922 participants were assessed and diagnosed with ADHD between 2005 and 2018.

Adults with ADHD are a diverse group with individual expressions of problems associated with attention difficulties, with or without hyperactivity-impulsivity. The requirements for diagnosis include impairments in social, work, or educational settings. The focus on psychosocial functioning is important for diagnosis and planning appropriate interventions.

The subjective severity of ADHD may be measured with different self-reported instruments. In this dissertation used the ADHD Adult Self-Report Scale (ASRS), an often-used severity rating scale for adult ADHD. Many adults with ADHD also have excessive anger episodes, described as ‘emotional dysregulation’. The severity of these symptoms was measured with the Deficient Emotional Self-Regulation (DESR) questionnaire.

The results of this study presented in this dissertation have been published internationally in five scientific articles. The main findings are as follows:

- As many as 50% of participants had one current comorbid psychiatric disorder, and 25% had two or more comorbid psychiatric disorders, most commonly major depression, social anxiety, and drug use disorders.
- Nearly 60% of our participants reported work as their main source of income. The prevalence of work participation was associated with positive social factors, such as living with someone and having children, and with not previously having severe depression.
- A total of 22% of women and 32% of men in our sample reported a lifetime history of drug use disorder (mainly amphetamine and cannabis), and this was associated with both higher hyperactivity-impulsivity and emotional dysregulation severity scores.
- A total of 12% of women and 25% of men in our sample reported a lifetime history of criminal conviction, and this was associated with both higher hyperactivity-impulsivity and emotional dysregulation severity scores.
- The severity of ADHD is emphasized in the DSM-5. We sought to investigate whether psychometric WAIS test scores have utility as an indicator of severity. The

psychometric index scores of verbal working memory (as WMI) and processing speed (as PSI) appear to have limited utility as an indicator of the severity of attention deficit and emotional dysregulation in adult ADHD.

ADHD research is often performed in state-funded, public clinics. In this dissertation, I show that patients in private clinics also show higher rates of psychiatric comorbidity, drug-abuse, and criminality, and lower rates of work participation, than the general population. This finding underscores the personal cost of having undiagnosed, untreated ADHD, and should alert authorities to recognise the struggle of this patient group.

Emotional dysregulation is an important feature in many people with ADHD and measuring emotional dysregulation may contribute to understanding ADHD comorbidity, particularly substance abuse and criminality.

Because ADHD is a dimensional diagnosis, I show that the severity of ADHD and the presence of additional emotional control problems, are both associated with drug use disorder and criminal conviction. I also show that neuropsychological measures of verbal working memory and processing speed are not suitable indicators of the objective severity of ADHD and emotional dysregulation.

Sammendrag på norsk:

Denne avhandlingen omhandler voksne med Attention Deficit Hyperactivity Disorder (ADHD). Rammen for studien er en privat psykiatrisk praksis i Oslo, hvor 922 klienter ble diagnostisert med ADHD i løpet av årene 2005-2018. Alle deltakerne samtykket til at bruk av deres kliniske informasjon til forskning.

Voksne med ADHD er mangfoldige og med individuelle uttrykk av oppmerksomhetssvikt, med eller uten hyperaktivitet-impulsivitet. Kravene til diagnosen inkluderer funksjonsnedsettelse i sosial, arbeids eller utdannings sammenheng, og søkelys på psykososial funksjon er derfor både diagnostisk og klinisk viktig.

Den subjektive alvorlighetsgraden av ADHD kan måles ved hjelp av selvrappoteringskjemaer. I denne avhandlingen er det brukt *ADHD Adult Self-Report Scale (ASRS)* som ofte brukes i måling av alvorlighetsgrad av ADHD symptomer. Mange voksne med ADHD lider også av emosjonelle utfordringer benevnt som emosjonell dysregulering, og alvorlighetsgraden av dette er målt med spørreskjemaet *Deficient Emotional Self-Regulation (DESR)*.

Resultatet av denne studien er publisert i fem vitenskapelige artikler som presenteres i denne avhandlingen. Hovedfunnene er:

- Hele 50 % av deltagerne hadde minst én komorbid psykiatrisk lidelse, og 25 % hadde to eller flere komorbide psykiatriske lidelser. De mest vanlige var alvorlig depresjon, sosial angst og ruslidelser.

- Nesten 60 % av deltakerne våre rapporterte arbeid som sin viktigste inntektskilde. Graden av arbeidsdeltakelse var knyttet til positive sosiale faktorer som å leve sammen med noen, og ha barn, og uten tidligere alvorlig depresjon.

- 22 % av kvinnene og 32 % av mennene i utvalget rapporterte en livshistorie med narkotikamisbruk (hovedsakelig amfetamin og cannabis), og dette var assosiert med både hyperaktivitet-impulsivitet og økt alvorlighetsgrad av emosjonell dysregulering.

- 12 % av kvinnene og 25 % av mennene i utvalget rapporterte å ha blitt dømt for kriminalitet, og dette var assosiert med økt hyperaktivitet-impulsivitet og økt alvorlighetsgrad av emosjonell dysregulering.

- ADHD er en dimensjonal diagnose der alvorlighetsgrad er vektlagt i DSM-5. Jeg ønsket å undersøke om objektive psykometriske WAIS-testresultater kunne ha nytte som indikator for subjektiv opplevd alvorlighetsgrad, men fant at de psykometriske indeks skårene for verbalt arbeidsminne (WMI) og prosesseringshastighet (PSI) hadde begrenset nytte som en alvorlighetsgrad indikator på oppmerksomhetssvikt og emosjonell dysregulering.

ADHD-forskning er ofte basert på pasientdata fra offentlige klinikker. I denne studien er det vist at selv i en privat psykiatrisk klinikk er det også der en høy forekomst av psykiatrisk komorbiditet, rusmisbruk, kriminalitet og lavere arbeidsdeltakelse, sammenlignet med befolkningen generelt. Dette understreker de personlige kostnadene ved å ha en uoppdaget og ubehandlet ADHD, og tydeliggjør utfordringene hos denne pasientgruppen.

Emosjonell dysregulering er et viktig trekk hos mange pasienter med ADHD, og kunnskap om emosjonell dysregulering kan bidra til økt forståelse av ADHD-komorbiditet, spesielt av rusmisbruk og kriminalitet.

List of papers in this dissertation:

1. Anker, E., Bendiksen, B., & Heir, T. (2018). **Comorbid psychiatric disorders in a clinical sample of adults with ADHD, and associations with education, work, and social characteristics: a cross sectional study** *BMJ open*, 8(3), e019700. DOI: 10.1136/bmjopen-2017-019700
2. Anker, E., Halmøy, A., & Heir, T. (2019). **Work participation in ADHD and associations with social characteristics, education, lifetime depression, and ADHD symptom severity.** *ADHD Attention Deficit and Hyperactivity Disorders*, 11(2), 159-165. DOI: 10.1007/s12402-018-0260-2
3. Anker, E., Haavik, J., & Heir, T. (2020). **Alcohol and drug use disorders in adult ADHD clinical population: Prevalence and associations with ADHD symptom severity and emotional dysregulation** *World Journal of Psychiatry*, 10(9), 202. DOI: 10.5498/wjp.v10.i9.202
4. Anker, E., Ginsberg, Y. & Heir, T. (2021) **Prevalence of criminal convictions in Norwegian adult ADHD outpatients and associations with ADHD symptom severity and emotional dysregulation.** *BMC Psychiatry* 21, 226 (2021). DOI: 10.1186/s12888-021-03223-0
5. Anker, E., Ogrim, G. & Heir, T. (2021) **Verbal Working Memory and Processing Speed: Correlations with the severity of Attention Deficit and Emotional Dysregulation in Adult ADHD** *Journal of Neuropsychology*. DOI: 10.1111/jnp.12260

Abbreviations:

ADHD: Attention Deficit Hyperactivity Disorder

AD: Attention Deficit

DSM: Diagnostic and Statistical Manual

APA: American Psychiatric Association

WHO: World Health Organization

DIVA: Diagnostisch Interview Voor ADHD bijvolwassenen

M.I.N.I.: Mini International Neuropsychiatric Interview

ASRS: Adult ADHD Self Report Scale.

AUD: Alcohol Use Disorder

DUD: Drug Use Disorder

SUD: Substance Use Disorder (AUD+DUD)

MADRS: Montgomery–Åsberg Depression Rating Scale

WAIS: Wechsler Adult Intelligence Scale

IQ: Intelligence quotient

FSIQ: Full Scale Intelligence Quotient:

- VCI: Verbal Comprehension Index
- POI: Perceptual Organizing index
- WMI: Working Memory Index.
- PSI: Processing Speed Index

1. INTRODUCTION

1.1 Attention deficit hyperactive disorder

According to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition, (DSM-5) (American Psychiatric Association, 2013), attention deficit hyperactive disorder (ADHD) is a neuropsychiatric disorder with core symptoms of inattention, hyperactivity, and impulsivity. ADHD is caused by a multitude of additive and interactive genetic and environmental factors functioning in a highly complex manner (Faraone & Larsson, 2019; Archer, Oscar-Berman & Blum, 2011, Thapar, Cooper, Eyre & Langley, 2013). The population prevalence of adult ADHD has been reported to be 3–5% (Faayad et al., 2007; Kessler et al., 2006; Thomas et al., 2015), and ADHD has been found to cause functional impairment and suffering (Kooij, Bejerot, ... Asherson, 2010). ADHD is a dimensional diagnosis in which attention deficits and hyperactivity-impulsivity may appear in various degrees and combinations (Willcutt et al., 2012). ADHD severity is graded as mild, moderate, or severe, where severe is defined when *“many symptoms in excess of those required to make the diagnosis, or several symptoms that are particularly severe, are present, or the symptoms result in marked impairment on social or occupational functioning”* (DSM-5, APA, 2013).

In the former diagnostic criteria of the DSM-IV (APA, 2004), three subtypes of ADHD were defined: inattentive, hyperactive-impulsive, and combined subtypes. ADHD subtypes are unstable over time, such that patients shift from one subtype to another (Lahey, 2005). In DSM-5 (APA, 2013), these subtypes are redefined as sub-presentations.

ADHD symptoms are not objective measures but instead are a cluster of clinical observations and subjective experienced difficulties in a patient. These subjective symptoms of ADHD have been gathered in the 18-item questionnaire Adult ADHD Self-Rating Scale (ASRS) (Adler, Kessler, & Spencer, 2003; Silverstein et al., 2018) (Table 1, page 14). ASRS was used herein to measure ADHD severity, with the two subscales Attention Deficit (items 1–4 and 7–11) and Hyperactivity-Impulsivity (items 5, 6, and 12–18).

Table 1. ADULT ADHD SELF-REPORT SCALE (ASRS-V1.1) SYMPTOM CHECKLIST

Please answer the questions below, rating yourself on each of the criteria shown using the scale on the right side of the page. As you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months. Please give this completed checklist to your healthcare professional to discuss during your appointment.	Never (0)	Rarely (1)	Some- times (2)	Often (3)	Very often (4)
PART A					
1. How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?					
2. How often do you have difficulty getting things in order when you have to do a task that requires organization?					
3. How often do you have problems remembering appointments or obligations?					
4. When you have a task that requires a lot of thought, how often do you avoid or delay getting started?					
5. How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?					
6. How often do you feel overly active and compelled to do things, like you were driven by a motor?					
PART B					
7. How often do you make careless mistakes when you have to work on a boring or difficult project?					
8. How often do you have difficulty keeping your attention when you are doing boring or repetitive work?					
9. How often do you have difficulty concentrating on what people say to you, even when they are speaking to you directly?					
10. How often do you misplace or have difficulty finding things at home or at work?					
11. How often are you distracted by activity or noise around you?					
12. How often do you leave your seat in meetings or in other situations in which you are expected to stay seated?					
13. How often do you feel restless or fidgety?					
14. How often do you have difficulty unwinding and relaxing when you have time to yourself?					
15. How often do you find yourself talking too much when you are in social situations?					
16. When you're in a conversation, how often do you find yourself finishing the sentences of the people you are talking to, before they can finish it themselves?					
17. How often do you have difficulty waiting your turn in situations when turn taking is required?					
18. How often do you interrupt others when they are busy?					

1.2 Assessment and treatment of ADHD

ADHD was first recognized in 1968 as ‘hyperkinetic reaction of childhood’ disorder (Diagnostic and Statistical Manual 2nd.edition, DSM-II, 1968) later recognized that in two-thirds of children with ADHD, the symptoms persist into adulthood (Biederman et al., 2006, Caye et al., 2016). The focus on ADHD among women is also growing, specifically about female hormone distortions that may mess up the clinical picture (Camara et al., 2021) and the ADHD condition being hidden and manifesting as various other psychiatric symptoms (Waite, 2010). Many people with ADHD are being found among school dropouts (Fried et al., 2016), drug users (van Emmerik-van Oortmerssen, 2012), and criminals (Young, Moss et al., 2015). The diagnostic criteria for adult ADHD are partly based on “*clear evidence that the symptoms interfere with, or reduce the quality of, social, academic, or occupational functioning*” (DSM-5, APA, 2013).

In Norway, treatment of ADHD in adults with stimulants was allowed from 1997, but only after application and special permission from the health authorities. From 2005, treatment was also allowed after individual assessment by a relevant medical specialist. Treatment of ADHD is unique in that the medical treatments are mainly central stimulants classified as narcotic drugs. Thus, the medical therapy for people with ADHD is easily criticized. “*Soon are we all patients*” is title of a book questioning the use of medication in Nordic countries (Bondevik et al., 2017), where non-physicians are worried. Other critics of ADHD medication have described a “*wave of ADHD medication*” (Dragland, 2021). Norwegian health authorities are also carefully watching the medical treatment of ADHD with central stimulants (Helsetilsynet, 2004).

1.3 Participants consenting to provide statistical material for this dissertation

People seeking psychiatric help with ADHD symptoms are diverse as people in general, but often ashamed of their incapacity. The people with ADHD who provided statistical material for this dissertation were most often positive, conscientious, hardworking, and committed. They encouraged this research and were eager to contribute. Even those with anger problems showed a self-reflection that was admirable. Nevertheless, discovering that so many of the patients had such serious challenges in life was thought-provoking.

This dissertation is based on the examination of 922 adult patients in a private psychiatric clinic. In this dissertation, all participants were diagnosed with ADHD according

to diagnostic criteria (APA, 2004; APA, 2013). The study was designed as an observational cross-sectional clinical study in the years 2005 to 2018, based on statistic material reported by the participants in clinical assessment, and was approved by the Regional Ethics Comity in 2015.

The participants described their symptoms as inattention, restlessness, or impulsivity, and indicated that they often faced two major challenges in life. The first described challenge was schooling, including difficulties in listening to a boring teacher (together with 20 pupils in a classroom), and being able to learn. The second major challenge was keeping up with boring administrative tasks, which they experienced as overwhelming. The participants often told they had good practical skills (e.g., being a good salesperson, carpenter, teacher, doctor, or lawyer) but still experienced severe difficulties in performing boring administrative duties. They indicated that the distinction between interesting and boring was crucial for their function.

Symptoms of attention deficit, impulsivity, and hyperactivity may be easily downgraded, but these symptoms of ADHD can also be described in a more uplifting way. Medical doctor Kristin Leer, who has ADHD, aims to translate ADHD symptoms to their positive counterparts, e.g., from easily distracted to curious; from forgetting the time to being engaged in the moment; from not sticking to the point to seeing connections that others overlook; from being hyperactive to energetic, impulsive to creative, or disorganized to spontaneous; from being stubborn to fighting for what one believes in; from performing unevenly to showing flashes of brilliance; from being unfocused to hyperfocused; and from always being late to being a time optimist (Leer, 2021).

1.4 Emotional dysregulation

Regulation of emotions has traditionally referred to the management of internal experiences and external expression of emotions (Gross,1998). Regulation or self-regulation of emotions are processes responsible for monitoring, evaluating, and modifying emotional reactions (Thompson, 1994), and for the ability to respond with a range of emotions that is sufficiently socially tolerable and flexible, as needed (Cole et al., 1994).

Emotional dysregulation covers a large variety of emotionally dysregulated responses, such as overwhelming sadness, anxiety, fear, anger, suicidal actions, and other emotional outbursts. The prefrontal cortex plays an important role in both the generation and the regulation of such emotions (Dixon et al., 2017). Emotional dysregulation is associated with

several diagnoses other than ADHD, such as depression and anxiety (Dvir et al., 2014), post-traumatic stress disorder and personality disorders (Ford & Cortious, 2021), brain injury (Fisher et al., 2015), and dementia (Ismail et al., 2018), and may be associated with early psychological trauma, chronic maltreatment, and reactive attachment disorder (Schechter & Willheim, 2009). Emotional dysregulation has also been reported in people with autism spectrum disorders (Hervas, 2017), bipolar disorder (Green et al., 2007), complex post-traumatic stress disorder (Pynoos, Steinberg & Piacentini, 1999; Brewin et al., 2017), foetal alcohol syndrome (Bjorquist et al., 2010), and early brain damage in children (O’Keeffe et al., 2014).

Emotional dysregulation may therefore be understood as a transdiagnostic factor (Gisbert et al., 2018) in the development of psychopathology (Aldao et al., 2016), and it appears to be specifically associated with impulsivity (Schreiber et al., 2012). In the DSM-5, impulsivity is broadly defined as “*actions that are poorly conceived, prematurely expressed, unnecessarily risky, and inappropriate to the situation*”. Emotional dysregulation has many similarities with the diagnoses of oppositional defiant disorder and disruptive mood dysregulation disorder described in in DSM-5 (APA, 2013).

In the 1950s and 1960s, ‘minimal brain damage’ and ‘minimal brain dysfunction’ were commonly used terms for children and adolescents with hyperactivity and concentration problems, often with emotional difficulties (Lange et al., 2010). The term hyperkinetic reaction of childhood was introduced in the DSM-II (Diagnostic and Statistical Manual version II, American Psychiatric Association, 1968), but was still referred to as minimal brain dysfunction (MBD), including emotional control problems (Wender, 1971, Wood et al., 1976). The DSM-III (APA, 1980) did limit the symptoms of ADHD to only inattention, hyperactivity, and impulsivity, excluding emotional control problems. Later DSM editions maintained this narrower focus, excluding emotional control problems in the diagnosis of ADHD. The argument for this distinction was that emotional control problems are not solely associated with ADHD, and many people with ADHD do not face such challenges.

The International Classification of Diseases (ICD) of the World Health Organization (WHO) first introduced the diagnosis of hyperactivity syndrome in childhood in ICD-8 (WHO, 1965). Later, in ICD-9 (WHO, 1977) and ICD-10 (WHO, 1992), this diagnosis was described as hyperkinetic disorder (the counterpart to ADHD), but emotional control problems have not been included within this ICD diagnosis.

In the 1970s, researchers from Utah described ADHD with possible elements of emotional symptoms, including temper, affect lability, and emotional reactivity (Wender, 1995; Wender et al., 2001). Many terms have since been used to describe emotional symptoms in ADHD, including emotional dysregulation, emotional lability, emotional reactivity, emotional impulsivity, and emotional instability (Conners et al., 1999), but also deficient emotional self-regulation, distress tolerance, frustration discomfort, and irritability (Faraone et al., 2019), thus resulting in clinical confusion. The clinical expression of, for example, emotional impulsivity is seen as excessive and inappropriate emotional expression, irritability, and temper outbursts (Shaw et al., 2014; Stringaris, 2011), and is also described as emotional lability (Skirrow and Ascherson, 2013). Perhaps ‘emotional lability’ might refer primarily to ‘endogenous’ fluctuations rather than a lack of regulation. Deficient emotional self-regulation is described as low frustration tolerance, temper outbursts, emotional impulsivity, and mood lability (Surman et al., 2013; Corbiciero et al., 2013).

Despite the confusion regarding these definitions, adults with ADHD often have difficulty in regulating negative emotions (Landaas et al., 2012; Connor et al., 2010; Shaw et al., 2014). They may be quick to anger, easily frustrated, and emotionally over-excitable (Barkley and Fischer, 2010; Martel, 2009; Faraone et al., 2019; Reimherr et al., 2020). Adults with persistent ADHD have higher rates of emotional dysregulation than adults whose childhood ADHD has remitted (Barkley, 2016; Barkley & Fischer, 2010; Biederman et al., 2012; Faraone et al., 2019). Emotional dysregulation has been proposed by many researchers to be an inherent part of ADHD (Haavik et al., 2010; Barkley, 2016; Barkley & Fischer, 2010; Faraone et al., 2019; Retz et al., 2012; Surman et al., 2013; Surman et al., 2011), and has been found closely associated with the severity of impairment (Barkley & Fischer, 2010; Biederman et al., 2012; Bunford et al., 2018; Sobanski et al., 2010; Surman et al., 2013).

Given that emotional dysregulation is shared with many other psychiatric conditions commonly co-occurring with ADHD (Chang et al., 2018; Dryman & Heimberg, 2018; Henry et al., 2012; Hofmann et al., 2012), the temporal relationships between emotional dysregulation and ADHD are of particular interest. Studies have suggested that emotional regulation problems are more strongly associated with ADHD itself than with its later occurring psychiatric comorbidities (Bunford et al., 2018; Corbisiero et al., 2017; Gisbert et al., 2018; Reimherr et al., 2005; Surman et al., 2013; Vidal et al., 2014).

Emotional dysregulation has been reported to be more associated with hyperactivity-impulsivity than attention deficit (Retz et al., 2012; Sobanski et al., 2010; Vidal et al., 2014;

Barkley, 2016; Barkley & Fischer, 2010; Corbisiero, et al., 2017). Researchers have also proposed to differentiate subgroups of ADHD according to the presence of emotional dysregulation (Hirsch et al., 2018; Reimherr et al., 2020). Adding emotional dysregulation severity to the concept of ADHD is in line with the emphasis by Reimherr et al. on using a two-factor classification of ADHD subgroups, with an ADHD presentation consisting solely of attention deficit, and an ADHD more comprehensively including a hyperactivity-impulsivity emotional dysregulation presentation (Reimherr et al., 2020). A distinct subtype has also been suggested on the basis of genetic findings of familial co-segregation of ADHD and emotional dysregulation (Surman et al., 2011; Biedermann et al., 2012). However, other researchers consider ADHD and emotional dysregulation to be modestly correlated yet still distinct symptom dimensions (Nigg et al., 2005; Banaschewski et al., 2012).

Studies of gender differences in emotional dysregulation among adults with ADHD have been sparse and inconsistent. Results from a family risk study have suggested that the degree of emotional dysregulation shows no gender differences in adult ADHD (Surman et al., 2011). Other reports have suggested that women with ADHD strive more than men to regulate negative emotions (Bunford et al., 2018; Gisbert, Richarte, Corrales, Ibanez, Bosch, Bellina, et al., 2019; Gisbert, Richarte, Corrales, Ibanez, Bosch, Casas, et al., 2018; Robison et al., 2008). General gender differences in reported anger are also of interest, and some researchers have found that women report more anger than men, in the setting of an anger outpatient clinic (Healey et al., 2019). These results are important because dysfunctional anger may be under-reported in women. Women with ADHD have also been reported to have more emotional symptoms and to be more impaired than men with ADHD (Robison et al., 2008; Cortese et al., 2016).

1.5 Emotional dysregulation in this dissertation

Dr. Russel Barkley, a leading scientist describing emotional dysregulation in ADHD, has posited that emotional dysregulation is a core defining feature of ADHD, in line with inattention, hyperactivity, and impulsivity (Barkley, 2010). He has described emotional dysregulation with both an inhibitory deficit and a self-regulatory deficit, which manifests in a failure to calm the psychological arousal from strong emotions, refocus the attention, and organize the self for coordinated action towards an external goal (Barkley & Fischer, 2010). Emotional impulsivity has been defined by Barkley as “*difficulties with emotion generation that is highly impulsive*” (Barkley et al., 2015). Barkley considers deficiency in emotional

self-regulation, impulsive emotion, and poor self-control of emotions to be important aspects of ADHD (Barkley, 2010), and describes people with ADHD as impatient, with a ‘short mood’, and a tendency to become easily frustrated and overreact (Barkley and Fischer, 2010). Emotional dysregulation is described by three domains: temper control, affective lability, and emotional over-reactivity/stress intolerance. The temper control refers to *‘feelings of irritability and frequent outbursts of short duration’*. Affective lability is associated with short and unpredictable *‘shifts from normal mood to depression or mild excitement’*. Emotional over-reactivity refers to *‘a diminished ability to handle typical life stresses, resulting in frequent feelings of being hassled and overwhelmed’* (Barkley, 2010), including cognitive, behavioural, and emotional aspects, which may have important clinical relevance in patients with ADHD (Shaw et al., 2014; Surman et al., 2011; Corbisiero et al., 2013; Retz et al., 2012).

Several questionnaires are used to measure emotional dysregulation, such as The Symptom Checklist (SCL-90), containing six emotional items (Derogatis et al., 1976); the Wender Utah Rating Scale (WURS) questionnaire, containing six emotional items (Ward et al., 1993); the Wender-Reimherr Adult Attention Deficit Disorder Scale (WRAADDs), containing 11 emotional items (Wender, 1995); Conners’ Adult ADHD Rating Scales (CAARS), containing five emotional items (Conners et al., 1999); and the Difficulties in Emotion Regulation Scale (DERS), containing 36 solely emotional items (Gratz & Roemer, 2004).

This dissertation embraces Barkley’s conceptual understanding of emotional dysregulation and uses his eight item Deficient Emotional Self-Regulation (DESR) questionnaire (Table 2, page 21.) as a dimensional scale to measure emotional dysregulation severity (Surman et al., 2013). These eight items are derived from the 99 item Current Behavior Scale – Self Report (CBS-SR) developed by Barkley (Barkley, 1997) and used by others (Surman et al., 2013; Biederman et al., 2020). Biederman et al. have recently shown that adults with ADHD with high scores (≥ 8) on the DESR scale have significantly more severe symptoms of ADHD and executive dysfunction than those with low DESR scale scores (< 8) (Biederman et al., 2020).

Table 2. Deficient Emotional Self-Regulation (DESR) questionnaire. Score range: 0 – 3

Please answer the questions below, rating yourself on each of the criteria shown using the scale on the right side of the page. As you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months.	Never or rarely (0)	Some-times (1)	Often (2)	Very often (3)
1: Quick to get angry or become upset				
2: Easily frustrated				
3: Overreact emotionally				
4: Easily excited by activities going on around me				
5: Lose my temper				
6: Argue with others				
7: Am touchy or easily annoyed by others				
8: Am angry or resentful				
Emotional dysregulation sum score (total score range: 0 – 24):				

1.6 Psychiatric comorbidity

Comorbidities in the sense of additional psychiatric disorders are associated with considerable impairment and burden to the individual, their family and the society (Fayyad et al., 2007). The prevalence of psychiatric comorbidity is higher in adults with ADHD than in the general population, with prevalence rates of comorbid psychiatric disorders ranging from 47% to 89% in various clinical samples (Sobanski, 2006; Jacob et al., 2007; Cumyn et al., 2009; Garcia et al., 2010; Fredriksen et al., 2014; Piñeiro-Dieiguez et al., 2016; Anastopoulos et al., 2016). The most common reported comorbid psychiatric disorders are anxiety disorders, mood disorders and drug abuse (Piñeiro-Dieiguez et al., 2016; Fredriksen et al., 2014).

Social benefits from spouse and children, and socio-economic circumstances such as education and work, are important measures of mental health (WHO 2012). Low socio-economic status, lower education, unemployment, marital disruption, and family difficulties are associated with higher prevalences of psychiatric disorders in the general population (Inaba et al., 2005; Kessler, Chiu et al., 2005; Andersen et al., 2009; Green & Benzeval, 2013; Paananen et al., 2013). Adults with ADHD have lower education achievements and higher rates of unemployment compared with the general population (Ebejer et al., 2012; Küpper et al., 2012), and they have more family instability (Jaber et al., 2015). Untreated are people with ADHD also an economic burden to the society (Garcia et al., 2010). We have found few studies that have examined whether social characteristics are associated with comorbid psychiatric disorders in adults with ADHD.

1.7 Work participation

As stated by the definition of ADHD it causes impairment and suffering in several domains of life (Kooij, Bejerot, ... Asherson, 2010; Thomas et al., 2015). The adverse consequences for the ability to cope in working life are of importance both at the individual as well as the societal level. Both longitudinal follow-up studies in children and cross-sectional studies of adults have reported associations between ADHD and an elevated risk of unemployment (Erskine et al., 2016; Halmøy et al., 2009; Gjervan et al., 2012; Sobanski et al., 2007), poorer work performance, changing or quitting jobs, and employment termination (Murphy & Barkley, 1996).

Occupational failure may be attributable to several factors including ADHD-specific symptoms themselves, such as inattentive symptoms (Fuermaier et al., 2021), comorbid

disorders, failures in education, or other social factors, including those associated with ADHD. However, knowledge is lacking regarding the factors that most strongly predict unemployment among working-age individuals with ADHD. For example, the severity of inattention in ADHD is associated with failures in work or education (Fredriksen et al., 2014). Moreover, unemployment has been found to be associated with lifetime diagnosis of a comorbid psychiatric disorder (Sobanski et al., 2007). A prospective study in children with ADHD has demonstrated an association between lower self-esteem and lower educational achievement, as well as lower occupational rank in adulthood (Slomkowski et al., 1995). According to a retrospective analysis, adults with ADHD tend to report a history of inferior performance and disciplinary problems in their school years (Murphey and Barkley, 1996), as well as lower education status (Ebejer et al., 2012; Küpper et al., 2012; Barkley et al., 2006). Several studies have identified a relationship between socioeconomic factors and childhood mental health, particularly ADHD (Bøe et al., 2012; Russell, et al., 2015). However, investigations of work participation among people with ADHD in adult life are lacking, as are studies performing comprehensive modelling of factors potentially associated with occupational outcomes among people with ADHD.

1.8 Drug use disorder

Comorbidity of substance use disorders (SUD) such as alcohol use disorder (AUD) or drug use disorder (DUD) has been studied in a variety of clinical and research settings. Overall, there has been found an earlier onset and an elevated risk of SUD in people with ADHD (Kessler et al., 2006; Cortese et al., 2016; Biederman et al., 2006; Wilens, 2007; Charach, Yeung and Climans, 2011; Solberg et al., 2018; Vogel et al., 2016; Fatséas et al., 2016; Young, Carruthers et al., 2015; Capusan et al., 2016), but the causal direction, underlying mechanisms, and clinical implications of these are still unclear.

Emotional dysregulation has also been found associated with SUD in adolescents (Sobanski et al., 2010) as well as adults with ADHD (Evren et al., 2019). The tight relationship between ADHD and emotional dysregulation (Shaw et al., 2014; Connor et al., 2010; Landaas et al., 2012) makes it challenging to determine which of them is more related to the prevalence of AUD and DUD.

1.9 Criminal conviction

ADHD often occurs with antisocial behaviour (Sourander et al., 2006; Mohr-Jensen & Steinhausen, 2016). Among male inmates several studies have estimated that the prevalence of ADHD ranging from 15-50% (Rösler et al., 2004; Einarsson et al., 2009; Ginsberg et al., 2010; Usher et al., 2013; Knecht et al., 2015). Meta-analyses of male inmates have indicated an average ADHD prevalence of approximately 25% (Young et al., 2015; Baggio et al., 2018) and even as high as 40% in female inmates (Farooq et al., 2016). These high rates far exceed the 3-5% prevalence estimated rates of ADHD in the general population (Fayyad et al., 2007; Kessler et al., 2006).

Longitudinal studies have found children with ADHD to have a high risk of later both antisocial activity and criminal conviction in adulthood (Fletcher & Wolfe, 2009). The long-term outcomes of children with ADHD in Denmark indicated that nearly half achieved a history of criminal conviction in adulthood (Dalsgaard et al., 2013). Other studies have found girls with ADHD to have 7 times higher odds of having a criminal record than non-ADHD girls, while boys with ADHD had only two times higher odds (Silva et al., 2014). A Swedish national register study found that fifteen% of women and thirty-six % of men with ADHD were convicted of any crime (Lichtenstein et al., 2012). There is a lack of ADHD studies comparing criminal convicted and non-criminal convicted as outcome for both genders (Retz et al., 2021).

Knowledge of the prevalence of criminal conviction even in a private ADHD outpatient clinic may help health authorities planning appropriate services. Over time it may help clinicians plan specialized and better treatments for adult ADHD. Measurements of the prevalence of criminal conviction may also contribute to the elucidation causes of this, and the achievement focus of treatment.

The correlation between criminal conviction or antisocial behaviour and the severity of ADHD has been shown in several studies (Young & Thome, 2011; Mohr-Jensen & Steinhausen, 2016; Mordre et al., 2011; Unnever & Cornell, 2003; Du Rietz et al., 2017). We aimed to confirm these findings in our study. Previous studies have found adjustment problems to be linked to also antisocial behaviour in adults with ADHD (Young and Gudjonsson, 2006). Antisocial behaviour is largely mediated by emotional lability and anger problems (Gudjonsson et al., 2014). Excessive emotional expressions, irritability, and temper outbursts may be understood as clinical expressions of emotional dysregulation (Shaw et al., 2014; Stringaris, 2011). Emotional dysregulation, irrespective of having ADHD, is associated

with aggressive and violent criminality (Garofalo & Velotti, 2017). Emotional dysregulation in adults is clinically like oppositional defiant disorder in youth linked to antisocial behaviour (Aebi et al., 2016; Pardini & Fite, 2010). Whether the severity of emotional dysregulation in adults with ADHD is associated with criminal conviction has yet to be shown.

1.10 WAIS measures – verbal working memory and processing speed

When assessing adults for ADHD some clinicians use results from neuropsychological tests to obtain objective measures of a patient's cognitive function to supplement the clinical assessments that are based on subjective self-report questionnaires (Fuermaier et al., 2018). There are several professional reasons for this tests. The symptoms of ADHD are extreme variants of normal behaviours, and the boundaries between normality and pathology are based on a clinical judgement. Studies have shown that the diagnosis of ADHD is highly dependent on source of the clinical report of the patient, and this is underscoring the need for a more objective assessment (Barkley, Fischer, Smallish, & Fletcher, 2002). In addition, some ADHD symptoms may be due to a presence of other disorders. Clinical challenges related to attention deficits in adult ADHD have been confirmed in several studies (Barkley, 2010a; Bush, 2010; Halleland, Haavik, & Lundervold, 2012; Seidman, 2006), and have also been reported in studies assessing the severity of the 9 DSM-defined inattentive symptoms (APA, 2013), as reflected in the Adult ADHD Self-Report Scale (ASRS, see page 14) inattentive subscore (items 1-4 and 7-11), (Fredriksen et al., 2014; Kessler et al., 2005; Silverstein et al., 2019). Adults with ADHD do also have an impaired executive functioning (Silverstein et al., 2020), but may not necessarily exhibit clear attention deficits on psychometric tests (Fabio & Capri, 2017).

There is a tight relationship between clinical anger and cognitive distortions (Chereji, Pintea, & David, 2012), and frequencies of both clinical anger and cognitive distortion are associated with impaired executive functioning (Persampiere, Poole, & Murphy, 2014). Psychometric testing of executive functioning has frequently been used in the neuropsychiatric assessment of adult ADHD, and one core feature of executive function is verbal working memory, which involves a mental retention of auditory information that enables future mental action of the patient (Diamond, 2013). A close relationship has been found between emotional regulation and working memory capacity (Barkley, 1997; Jasielska et al., 2015; Jensen et al., 2018; Lima, Peckham, & Johnson, 2018; Rutherford, Booth, Crowley, & Mayes, 2016).

Working memory is an important executive function (Baddeley & Hitch 1974; Diamond, 2013), and in adults with ADHD working memory deficits are well documented (Alderson, Kasper, Hudec, & Patros, 2013). Psychometric tests of working memory may be used in both children and adults to determine those with ADHD (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2015). According to neuropsychologist Allan Baddeley, working memory consists of a central executive and two content and modality-specific components. This is the phonological loop that handles verbal content and the visuospatial sketchpad that handles spatial content (Baddeley & Logie, 1999). Attention control is strongly related to central executive functions, but according to several scientists, attention deficits in ADHD seems stronger related to the visuospatial memory component than with the phonological sketchpad (Woods, Lovejoy, & Ball, 2002; Faraone & Biederman, 2005; Nigg et al., 2005). Different neuropsychological models have been developed to gain insight into the working memory deficits also in adults with ADHD (Barkley, 1997; Diamond, 2005; Rapport, Chung, Shore, & Isaacs, 2001). We wanted to analyse whether verbal working memory deficits was correlated with the severity of either attention deficits or emotional dysregulation in adult ADHD.

Processing speed tests measure the efficiency of executive cognitive skills, and impairments of this psychometric test have been linked to attention deficits in both children with ADHD (Kibby, Vadnais, & Jagger-Rickels, 2019; Thorsen et al., 2018) and adults with ADHD (Tucha et al., 2017). Impairment in the processing speed explains to a large extent the impairment in the executive functions (Butzbach et al., 2019). Impaired processing speed is also in children with ADHD linked to inattentive behaviour (Kubo et al., 2018), and slow processing speed predicts slower social functioning in ADHD patients with inattention (Thorsen et al., 2018). It has been shown that slower processing speed and attention deficit coexist and are both important predictors of academic achievement (Mayes & Calhoun, 2007).

Scientific studies have shown that the results of psychometric WAIS test battery may be used to discriminate well between adults with and without ADHD, although the intragroup heterogeneity is emphasized (Woods et al., 2002; Frazier, Demaree, & Youngstrom, 2004; Thaler, Bello, & Etcoff, 2013; Theiling & Petermann, 2014). Measures of working memory and processing speed may also be used to discriminate well between ADHD and control groups (Nikolas, Marshall, & Hoelzle, 2019). Deficits in verbal working memory have one time been reported to be associated with parent-rated emotional dysregulation in children with

ADHD (Bunford et al., 2018), but others have not found this association, at least not in adults with ADHD (Chereji et al., 2012; Skirrow & Asherson, 2013). In our sample, we wanted to measure the correlations between processing speed and the severity of attention deficits and emotional dysregulation. The ADHD symptom severity is emphasized in the DSM-5 (APA, 2013), but whether the WAIS test scores are useful as severity indicators of attention deficits and emotional dysregulation is still unknown.

We want to hypothesize that verbal working memory and processing speed are correlated with the severity of attention deficits and emotional dysregulation, even after controlling for other variates. The covariates that can affect the associations between neurocognitive test and the clinical features of ADHD include age (Ardila, 2007), gender (Rucklidge & Tannock, 2001), education level (Reitan & Wolfson, 1995), and depression (Gorlyn et al., 2006).

2. AIMS OF THE STUDY

The overall aim of this study was to provide more knowledge about the clinical variety of adult ADHD patients in a private psychiatric clinic.

The first aim of our study was to examine prevalence of psychiatric comorbidity and the associations to social characteristics, educational level, work participation.

The second aim was to estimate the prevalence of work participation among people with ADHD, and to examine potential associations between gender, age, and social characteristics such as marital status, living with children, living in a city, or education level and work participation. We additionally sought to examine whether IQ, a history of lifetime major depression, ADHD-subtype, or symptom severity of ADHD might be associated with occupational outcomes.

The third aim was to estimate the prevalence of substance use disorders (SUD) as alcohol use disorder (AUD) and drug use disorder (DUD) in a clinical sample of adult ADHD patients and to examine association to ADHD and emotional dysregulation symptom severity.

The fourth aim was to reveal the prevalence of self-reported criminal convictions, and to examine its associations with ADHD and emotional dysregulation symptom severity.

The fifth aim was to investigate if the neuropsychological WAIS test results of verbal working memory and processing speed were useful as severity indicators of attention deficits or emotional dysregulation. To broaden our understanding of this topic between subjective and objective measures, we also wanted to determine whether each inattentive item and emotional dysregulation item correlated with the neuropsychological test results of verbal working memory and processing speed.

3. MATERIAL AND METHOD

3.1 Study Design

This was a cross sectional observational clinical study.

3.2 Procedure

The data were collected by a psychiatrist during routine assessment in an outpatient clinic. After assessment, the patients were asked if they approved the use of their clinical information in an anonymised form as statistic material for this clinical study.

3.3 Participants

The study population consisted of adult outpatients, aged 18 to 65 of both genders, who fulfilled the diagnostic criteria for a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (APA, 2004), or later Fifth Edition (DSM-5) (APA, 2013). They were all admitted to a private outpatient psychiatric clinic in Oslo, specialized in clinical assessment and treatment of adults with ADHD. Patients participating in the study were assessed by a psychiatrist with the semi-structured Diagnostic Interview for ADHD in Adults, second edition (DIVA 2.0; Kooij & Francken, 2010). The DIVA 2.0 is a reliable tool for assessing and diagnosing adult ADHD (Ramos-Quiroga et al., 2019).

Recruitment was conducted between 2005 and 2018. During these years, 1134 of the assessed patients fulfilled the diagnostic criteria of ADHD and were invited to participate in the study, of whom 65% were self-referred and 35% were referred by healthcare practitioners. There were no exclusion criteria.

Out of a total number of 1134 patients (580 men and 554 women) with ADHD, 922 (81.3%) gave their written consent to participate in the study. The five different research papers have used a slightly different number of participants according to the publication date and the gathered information from the assessment. Due to a research approach and increasing clinical experience, the quality of the assessment increased over the years.

3.4 Measures

3.4.1 Demographic factors

The age of the participants was recorded as their numbers of lived years when entering the study. Gender was recorded as women and men from the information revealed by the participant.

Sociodemographic information: If the participant was married or cohabiting this was scored as 1; and if not, it was scored as 0. If the participant was living with children also part-time (but not if having children somewhere else) this was scored as 1, and if not (event though having children somewhere else) was scored as 0. Educational level was categorized by the number of years in education; 12 years or less was scored as 1, 13-15 years was scored as 2, and more than 15 years was scored as 3. Work participation was defined as ‘yes’ and scored as 1, if work was reported as their main source of income, and if not was scored as 0.

3.4.2 ADHD severity

All participants were considered to have severe symptoms, i.e., they had many symptoms in excess of those required to make the diagnosis, or several symptoms that were particularly severe, or the symptoms resulted in marked impairment in social, educational or occupational functioning. ADHD presentation was not considered.

ADHD symptom severity was measured by using the Adult ADHD Self-Report Scale (ASRS) Symptom List, v1.1 (Adler, Kessler, & Spencer, 2003; Adler et al 2006; Kessler et al., 2005, WHO, 2007) (Table 1, page 14). The ASRS is a reliable and valid instrument for evaluating ADHD in adults (Silverstein et al., 2017). This 18-item version yields a score ranging from 0 to 72 points. We recorded subdivisions of the ASRS questionnaire, as inattentive items (item 1-4 and 7-11) and hyperactive - impulsivity items (item 5, 6, and 12-18) separately (Fredriksen et al., 2014).

3.4.3 Emotional dysregulation

Emotional dysregulation was assessed using eight relevant items from Russel Barkley’s 99 item Current Behaviour Scale - Self Report questionnaire (Barkley, 1997; Barkley 2010; Surman et al., 2013; Biederman, Petty et al., 2008) captured in Deficient Emotional Self-Regulation (DESR) questionnaire (Surman et al., 2013). There has been suggested to put a threshold of emotional dysregulation presence with a score above 8, in

other words max answer “sometimes” at each answer (Surman et al., 2013). In this dissertation we used the eight items Deficient Emotional Self-Regulation (DESR) scale as a dimensional scale to measure emotional dysregulation severity. The eight items were; 1: Quick to get angry or become upset; 2: Easily frustrated; 3: Overreact emotionally; 4: Easily excited by activities going on around me; 5: Lose my temper; 6: Argue with others; 7: Am touchy or easily annoyed by others; 8: Am angry or resentful. The items were by participant marked as never or rarely (0), sometimes (1), often (2) and very often (3). This yielded a total emotional dysregulation score ranging from 0 to 24 (Table 2. Page 22).

3.4.4 Psychiatric comorbidity

Psychiatric comorbidity was diagnosed using the Mini International Neuropsychiatric Interview (M.I.N.I.) (Leiknes et al, 1992-2009), according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria. (Sheehan et al., 1997; Sheehan et al., 1998). Alcohol and drug use disorders were diagnosed using the specific module of the Mini International Neuropsychiatric Interview (M.I.N.I.), Norwegian Translation Version 6.0.0 (Mordal, Gundersen, Bramness, 2010), according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria. (Sheehan et al., 1997, Sheehan et al., 1998). Dependence and abuse were merged to “use” disorder (as in M.I.N.I. version 7.0 / DSM-5), and questions were both restricted to the last 12-mo and related to lifetime prevalence.

The level of depression was measured by the Montgomery–Åsberg depression rating scale (MADRS), with all ten items summarized as a total score ranging from 0 to 60 (Montgomery & Åsberg, 1979). The MADRS is a reliable and valid screening instrument for the evaluation of depression (Davidson et al., 1986).

Criminal conviction was recorded as positive and scored as 1, when participant self-reported criminal conviction, and we recorded what they were convicted of. Absence of criminal conviction was scored as 0.

3.4.5 WAIS - Working memory and processing speed

Verbal working memory was assessed by the Working Memory Index (WMI; tests of Arithmetic, Digit Span and Letter-Number Sequencing), and processing speed was assessed with the Processing Speed Index (PSI; tests of Digit Symbol-Coding, Symbol Search) from the Wechsler Adult Intelligence Scale, 3rd edition (WAIS-III). (Evers et al., 2012; Kaufman,

1999; Wechsler, 1997; Wechsler, Nyman, & Nordvik, 2003) The test scores included in the statistical analyses were the age-corrected scale scores.

3.5 Data analysis

Numbers with percent proportions (%) were reported for all categorical variables. Means with standard deviations (SD) were given for continuous variables. We performed chi-square tests or t-tests to compare sociodemographic characteristics between participants and non-participants, and between men and women, in the first two articles. In the next two articles we performed chi-square tests or t-tests to compare between genders, and between outcome and no-outcome. We used linear or logistic regression analyses to examine associations between dependent variables and independent variables. All tests were two-tailed, and differences were considered significant if $p < 0.05$. Because of our two hypotheses in paper III and V, we used multiple test correction according to Bonferroni, considering differences significant if $p < 0.025$.

To avoid bias in the regression analysis of criminal conviction we have decided not to control for probable intermediate variables (or a proxy for an intermediate variable) in the causal pathway between ADHD or emotional dysregulation severity and criminal behaviour (Rothman & Greenland, 1998; Gilthorpe et al., 2015; Schisterman et al., 2009). For example, we had previously reported that both ADHD severity and emotional dysregulation are associated with alcohol and drug use disorders (Anker, Haavik & Heir, 2020). ADHD and emotional dysregulation develop early in life. Furthermore, because stable features of emotional and behaviour reaction patterns are not substantially influenced by external circumstances (Eisenberg et al., 2010), they can be considered causative factors in these relationships. In addition, alcohol and drug use have been established as strong risk factors for criminal behaviour (Dowden & Brown, 2002). Thus, alcohol and drug use disorders appear to be either intermediate variables in the causal pathway linking ADHD or emotional dysregulation with criminal behaviour, or a proxy for another intermediate variable, e.g., a high-risk social environment, within the causal pathway. The same argument is also applicable to several additional variables, such as education, family relationships, and employment. Intermediate variables (or a proxy for an intermediate variable), if controlled in an analysis, would tend to bias the results towards the null; in the literature, this practice has been described as an overadjustment that should be avoided (Rothman & Greenland, 1998; Gilthorpe et al., 2015; Schisterman et al., 2009).

We examined associations between measures of self-reported attention deficit (the ASRS subscore), or self-reported emotional dysregulation (the DESR questionnaire) as the dependent/outcome variables, and sociodemographic variables, the MADRS score, the Working Memory Index (WMI) and the Processing Speed Index (PSI) as the independent variables (linear regression). The test scores from the WAIS-III included in the statistical analyses were the age-corrected scale scores. We used Cronbach's alpha to assess the internal consistency and reliability of the eight items from the DESR scale. Cronbach's alpha for the eight scale items in our sample was .86, indicating high internal consistency.

For all association tests, beta ratios with 95% confidence intervals were calculated as the measurement of the effect size. To measure the explained variance, we used the R²-squared value. If the R²-squared value was <.30, the effect was considered weak. If the R²-squared value was between .30 and .50, the effect was considered moderate. If the R²-squared value was >.50, the effect was considered strong (Moore, Notz, & Notz, 2006).

We used Pearson correlation analyses to examine the associations of each of the nine attention deficit items on the ASRS and each of the eight emotional dysregulation items on the DESR scale with the Working Memory Index (WMI) and the Processing Speed Index (PSI).

There were no missing data. All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 22 (IBM, 2013).

3.6 Ethical considerations

The study was approved by the Regional Medical Ethics Committee, South-East Norway, 2015/426. Assessments were carried out in accordance with ethical standards, and the principals of the Declaration of Helsinki. Written consent to participate in the study was obtained from all participants.

4. SUMMARY AND RESULTS

4.1 General results of the study

ADHD symptom severity (total ASRS score) mean in our 629 sample was 50.4 (SD 9.5) among men, and 52.3 (SD 9.5) among women. Inattention mean score (ASRS inattentive sub-score) was 27.0 (SD 4.6) among men and 27.8 (SD 4.9) among women. Hyperactivity-Impulsivity mean score (ASRS Hyperactivity-Impulsivity sub score) was 23.3 (SD 6.6) among men and 24.7 (SD 6.5) among women. All gender differences were significant ($p < 0.001$).

Emotional dysregulation (DESR questionnaire score) in our 629 sample was mean 12.2 (SD: 2.8). We found a significant difference ($p < 0.001$) between emotional dysregulation score of women mean 13.5 (SD: 5.24), compare to men mean 11.2 (SD: 5.60) in our sample.

With a selected threshold of having emotional dysregulation (DESR questionnaire score) above 8, as done by others (Surman et al., 2013) i.a. answering one more then only “sometimes” at each answer, we found that in our 629 sample; 167 (26.9%) answered 8 or below, and 462 (73.1%) answered above 8. This interpreted as emotional dysregulation was frequent in our sample.

We found a strong correlation between:

- Emotional dysregulation and attention deficit; Pearson correlation 0.36 $p < 0.001$
- Emotional dysregulation and hyperactivity-impulsivity; Pearson correlation 0.46 $p < 0.001$
- Attention deficit and hyperactivity-impulsivity; Pearson correlation 0.39 $p < 0.001$

In a subsample of participants with diagnosis ADD only ($n=98$), emotional dysregulation was also positively correlated with attention deficit ($p < 0.001$).

4.2 Results of psychiatric comorbidity

The results were presented in the article *Comorbid psychiatric disorders in a clinical sample of adults with ADHD, and associations with education, work, and social characteristics: a cross sectional study* (Anker, Bendiksen & Heir, 2018). In this study we examined prevalence of comorbid psychiatric disorders using the Mini International Neuropsychiatric Interview (M.I.N.I.) and associations with education, work participation, and social characteristics. Adults in our sample reported high rates of comorbid disorders, educational and occupational failure, and family instability.

In this clinical sample 46.2% reported an education level above high school level (>12 years), 60.4% reported positive work participation, and 53.5% had at least one current comorbid psychiatric disorder. The most prevalent disorders were major depression (17.3%), substance use disorders (13.5%) and social phobia (14.2). Women had more eating disorders (13.0%) than men (1.1%), whereas men had more alcohol (10.0%) and substance use disorders (23.6%) compared to women (4.0%, 9.4%).

Lower rates of comorbid disorders were associated with education level above high school level (>12 years) (OR: 0.52, $p < 0.001$) and work participation (OR: 0.63, 95%CI: 0.43 – 0.92, $p = 0.018$). Age, marital status, living with children or living in the city was not associated with comorbidity.

Regarding individual diagnoses, higher education was associated with lower risk of social phobia (OR: 0.67, 95%CI 0.50-0.97, $p=0.033$). Work participation was associated with lower risk of major depression (OR 0.58, 95%CI 0.37-0.91, $p=0.017$), substance abuse (OR 0.29, 95%CI 0.10-0.84, $p=0.022$), substance dependence (OR 0.44, 95%CI 0.28-0.69, $p<0.001$), and PTSD (OR 0.52, 95%CI 0.31-0.87, $p=0.013$).

We concluded that adult ADHD was associated with high rates of comorbid psychiatric disorders, irrespective of gender and age. It appears that higher education and work participation were related to lower probability of comorbidity. IQ was poorly related to comorbidity, educational level, and work participation.

4.3 Results of work participation

The results of this study were presented in the article: *Work participation in ADHD and associations with social characteristics, education, lifetime depression, and ADHD symptom severity* (Anker, Halmøy & Heir, 2019). Here we examined degree of reported work participation in adult patients with ADHD, and associations with social characteristics, education, lifetime depression and ADHD symptom severity.

ADHD was diagnosed according to DSM-IV criteria, and ADHD subtypes recorded accordingly. Lifetime depression was diagnosed using the specific module of the Mini International Neuropsychiatric Interview (M.I.N.I.). Occupational status, and other social characteristics like marital status and living with children, were recorded. Intelligence (IQ) and symptom severity of ADHD (ASRS score) were assessed in subsamples of participants ($n=526$ and $n=567$ respectively). Work was defined when participants reported work as their main source of income.

In this sample of adults with ADHD (mean age 36.9 years, 48.5 % women), 55.3% of the women and 63.7% of the men were working at the time of inclusion. Work participation was associated with being male (women versus men: OR 0.55, 95%CI: 0.40-0.75, $p < 0.001$), being married or cohabitant (OR: 1.65, 95%CI 1.16-2.36, $p = 0.006$), or living with children (OR: 3.61, 95%CI:2.49-5.23, $p < 0.001$), as well as a lifetime story without major depression (OR: 0.62, 95%CI: 0.45-0.96, $p = 0.004$). Age, education, ADHD subtype, and ADHD symptom severity were not significantly associated with work participation. IQ was significantly associated with work participation in unadjusted analysis, but not when adjusted for other covariates.

We concluded that occupational outcome in adults with ADHD appears to be more associated with social characteristics and a life history without depression, rather than with IQ, ADHD subtype or ADHD symptom severity.

4.4 Results of substance use disorder

The results of this study were presented in the article: *Alcohol and drug use disorders in adult ADHD clinical population: Prevalence and associations with ADHD symptom severity and emotional dysregulation* (Anker, Haavik & Heir, 2020).

Alcohol and drug use disorders were diagnosed using the specific module of the Mini International Neuropsychiatric Interview (M.I.N.I.), Norwegian Translation Version 6.0.0, according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria. (Sheehan et al 1997, Sheehan et al 1998). Dependence and abuse were merged to “use” disorder (as in M.I.N.I. version 7.0 / DSM-5), and questions were both restricted to the last 12-mo and related to lifetime prevalence.

The lifetime prevalence of Alcohol use Disorder (AUD) in men was 14.8% and in women 8.6%. The lifetime prevalence of Drug use Disorder (DUD) in men was 32.5% and in women 22.0%. Men had a significantly higher prevalence of both AUD and DUD compared to women, and the prevalence of DUD was more than twice the prevalence of AUD for both sexes. In the total sample, 162 (27.7%) of the participants had a history of lifetime DUD related to amphetamine ($n = 112$, 69.1%), cannabis ($n = 100$, 61.7%), cocaine or ecstasy ($n = 43$, 26.5%), benzodiazepines ($n = 43$, 26.5%), heroin or other opioids ($n = 17$, 10.5%), and multiple unspecified drugs ($n = 26$, 16.0%).

Lifetime AUD was not significantly associated with the levels of ADHD symptoms or emotional dysregulation when adjusted for gender and age. Lifetime DUD, on the other hand,

was significantly associated with both hyperactivity-impulsivity (OR: 1.04, 95%CI: 1.01-1.08, $p = 0.021$) and emotional dysregulation (OR: 1.05, 95%CI: 1.01-1.09, $p = 0.019$), but not with attention deficit.

4.5 Results of criminal conviction

The results of this study were presented in the article: *Prevalence of criminal convictions in Norwegian adult ADHD outpatients and associations with ADHD symptom severity and emotional dysregulation* (Anker, Ginsberg & Heir, 2021).

Participants with a history of criminal conviction were more often men, had a lower educational level, were less involved in family life and work, and had a higher risk of a history of alcohol or drug use disorders than those without a history of criminal conviction.

In our sample the prevalence of criminal conviction was 11,7% (n=34) in women and 24.5% (n=83) in men. Among women, the most common conviction was for selling or possessing drugs (n=18; 6.2%), followed by violence, (n=6; 2.1%), traffic crime (n=6; 2.1%), steeling (n=2; 0.7%), and mixt or plural convictions (n=2; 0.7%). Among men, the most common conviction was for selling or possessing drugs (n=32; 9.4%), followed by violence, (n=24; 7.1%), traffic crime (n=14; 4.1%), steeling (n=5; 1.5%), and mixt or plural convictions (n=8; 2.4%).

Hyperactivity-Impulsivity and emotional dysregulation symptom severity were significantly higher in patients who had a history of criminal conviction, and criminal conviction were associated with hyperactive-impulsive symptoms (OR: 1.09, 95%CI: 1.04 - 1.13, $p < 0.001$) and emotional dysregulation (OR: 1.07, 95%CI: 1.02 - 1.12, $p = 0.006$) even when adjusted for age and gender. There were no significant interactions between age, gender, hyperactive-impulsive symptom severity and emotional dysregulation.

4.6 Results of WAIS with working memory and processing speed

The results of this study were presented in the article: *Verbal Working Memory and Processing Speed: Correlations with the severity of Attention Deficit and Emotional Dysregulation in Adult ADHD* (Anker, Ogrim & Heir, 2021).

We found that the mean Full-Scale Intelligence Quotient (FSIQ) in our sample was 103.2 (SD: 13.8), and females had an average FSIQ of 101.3, while men had an average FSIQ of 104.8. Both sexes had typical profiles with significantly reduced scores on the Working

Memory Index (WMI) and Processing Speed Index (PSI) compared to those expected based on their FSIQ.

The severity of attention deficits, as reflected in the ASRS attention deficit subscale score, was significantly correlated only with the PSI (Pearson correlation 0.16, $p < 0.001$).

The severity of hyperactivity and impulsivity, as measured by the ASRS hyperactivity-impulsivity subscale, was significantly correlated with the FSIQ (Pearson correlation 0.19, $p < 0.001$), and all four subindex scores.

The severity of emotional dysregulation, as measured by the DESR scale score, was significantly correlated with the FSIQ (Pearson correlation 0.23, $p < 0.001$) and with all four subindex scores.

In a linear regression model of the associations between the outcome/ dependent variable attention deficit severity, as measured by the ASRS inattention subscore, and the independent variables of age, sex, education level, depression, the WMI, and the PSI. The PSI ($B = 0.056$, 95%CI: 0.094 - 0.017, $p = .005$) but not the WMI ($B = 0.012$, 95%CI: 0.049 - 0.025, $p = 0.52$) was associated with attention deficits. The R square (explained variance) for the fully adjusted model was .026, that is the model explained only 2.6% of the variance in attention deficits in our sample. None of the covariates were significantly associated.

In a linear regression model of the associations between the severity of emotional dysregulation, as measured by the DESR scale, as the outcome/dependent variable and the independent variables of age, sex, education level, depression, the WMI and the PSI. Neither the WMI ($B = 0.05$, 95%CI: 0.095 to 0.002, $p = 0.041$) nor the PSI ($B = 0.03$, 95%CI: 0.08 to 0.13 $p = 0.22$) were associated with the severity of emotional dysregulation in the adjusted model after the Bonferroni correction, with significance based on $p < 0.025$. Depression was associated with the severity of emotional dysregulation ($B = 0.13$, 95% CI: 0.05–0.21, $p = 0.002$). The R-squared value (explained variance) for the fully adjusted model was .098, that is the model explained only 9.8% of the variance in emotional dysregulation in our sample. Age and education level did not contribute to the explained variance, but being female was significantly associated with emotional dysregulation ($B = 2.13$, 95% CI: 3.18 to 1.09, $p < 0.001$), and depression was also significantly associated with emotional dysregulation ($B = .13$, 95% CI: 0.05–0.21, $p = 0.002$).

Nine attention deficit items in the DSM-5 ADHD criteria do correspond to nine inattentive items on the ASRS (items 1-4 and 7-11), and these have been measured with the Pearson correlations with the WMI and PSI and their significance (2-tailed). Four items

pertaining to attention deficits were correlated with the WMI (ASRS items 1, 3, 7, and 9), and four items were correlated with the PSI (ASRS items 2, 3, 9, and 11). Three items were correlated with neither (ASRS items 4, 8, and 10).

Eight items pertaining to emotional dysregulation composing the Deficient Emotional Self-Regulation (DESR) scale, have been measured as the Pearson correlations with the WMI and the PSI and the significance (2-tailed). All but one item (DESR item 4: Easily excited by activities going on around me) were correlated with both the WMI and PSI.

5. DISCUSSION

5.1 Gender differences in the presentation of ADHD and emotional dysregulation

In our sample men and women reported significant differences in attention deficits, hyperactivity-impulsivity, and emotional dysregulation severity, where women reported higher severity scores for all three parameters. This is in line with other studies that have found that women report more severe symptoms of inattention and hyperactivity-impulsivity compared with men (Vildalen et al., 2019). This is also consistent with studies reporting this gender differences of emotional dysregulation in adult ADHD (Robison et al., 2008; Bunford et al., 2018; Corbisiero et al., 2013; Gisbert, Richarte et al., 2019; Gisbert et al., 2018).

From other studies we know that women tend to report greater affect intensity, and more intense positive and negative emotions compared with men (Brody, 1997; Hyde, 2014; Plant, et al., 2000; Rudolph, 2002). Irrespective of ADHD, self-report bias of emotions may be due to higher emotional awareness in women compared to men, which also fits the gender role expectations of women being the more emotional gender (Barrett & Bliss-Moreau, 2009; Nolen-Hoeksema, 2012). Conversely, Surman and colleagues found no gender differences of emotional dysregulation in their study (Surman et al., 2013).

However, the fact that men and women in our sample reported different severity scores of ADHD and emotional dysregulation could possibly be due to recruitment differences to the clinic, a sample selection bias. It may be more difficult to suspect ADHD in women, or the threshold for seeking help at the clinic may be higher for women. The women who come for examination thus have more serious symptoms compared to men. Even though women and men report differently in terms of ADHD and emotional dysregulation symptoms severity in this sample, this may not be so in the general population of people with ADHD.

5.2 Discussion of psychiatric comorbidity

In our sample of adults with ADHD about 50% of the participants had at least one comorbid psychiatric disorder. The most prevalent disorders were substance use disorders, social phobia, and major depression. Women had more eating disorders, whereas men reported more alcohol and substance use disorders. Higher education and positive work participation were associated with lower frequency of comorbidity.

The prevalence of a comorbid psychiatric disorders were about 50%, and similar or in the lower range of what others have found in adults with ADHD (Sobanski, 2006; Jacob et al., 2007; Cumyn et al., 2009; Garcia et al., 2010; Fredriksen et al., 2014; Piñeiro-Diequez et al., 2016; Anastopoulos et al., 2016). The mental disorders we examine are the same as those common in the general population, but they appeared to be more frequent (Baumiester & Harter, 2007). In fact, the prevalence of comorbid psychiatric disorder was about twice as high as in the general population (Andrews et al., 2001; Jacobi et al., 2004; Bijl et al., 1998; Kessler et al., 2005; Kringlen et al., 2001).

This may have several reasons, such as common genetic dispositions for mental disease, increased psychological vulnerability due to ADHD symptomology, or lower resilience due to social or socioeconomic consequences of ADHD. Our results are also most relevant to the possible effects of social and socioeconomic factors. Unemployment was associated with higher probability of psychiatric comorbidity, and this is in accordance with a German study that showed ADHD patients with a lifetime diagnosis of a comorbid psychiatric disorder were also more often unemployed compared to patients with pure ADHD (Sobanski, 2006). Unlike the German study, we found that education was related to psychiatric comorbidity. Both findings make sense when compared to general population studies, where psychiatric morbidity is more common among unemployed and people with less education (Kringlen et al., 2001, Baumiester & Harter, 2007, Gonçalves et al., 2014), and rates of almost all psychiatric disorders decreases with increased income and education (Kessler et al., 1994).

Authors have thought that educational attainment may represent a proxy for IQ when individuals with higher IQs stay longer within education (Batty et., 2007). However, in our study, this relationship between education and comorbid mental disorders was independent of IQ, and IQ was also poorly related to psychiatric comorbidity. Our findings indicate that there must be other factors that are more important for educational attainment in people with ADHD than pure intelligence, and that this intelligence does not protect against comorbid psychiatric disorders.

Work participation and educational achievement increases income and social status and serve as important arenas for investment in social capital. All these are important for preventions of mental illness. It is also possible that people with a current comorbid psychiatric disorder also have a previous history of mental illness that made it harder to get education and work participation. Socioeconomic factors and mental health may therefore

have interfered with each other in a dynamic process that has affected both education, work participation and the likelihood for mental illness.

Diagnoses such as depression, bipolar disorder, drug use disorders and eating disorders appeared to be more common in people with ADHD compared to what has been found in the general Norwegian population (Kringlen et al., 2001). The reason for this may vary for various disorders. Inadequacy in coping with life stressors has been proposed as a theory of depression (Rodgers, 1991; Hammen, 2005). "Self-medication" has been suggested to explain the relationship between ADHD and substance use (Ameringer & Leventhal 2013; Capusan et al., 2016). Our findings indicate that employment may be preventive to both depression and substance use disorders, or the disorders may reduce health which then affected the ability to work.

We found more eating disorders among women and more alcohol and substance use disorders among men, and this gender differences are in line with evidence from other ADHD comorbidity studies (Cumyn et al., 2009; Rasmussen, 2009). This gender difference is like the one also found in the general population (Kessler et al., 1994; Kringlen et al., 2001; Baumeister & Harter, 2007). It is impossible to know to what extent gender differences are unique to ADHD or simply reflect general population patterns of gender specific aetiology (Williamson & Johnson, 2015).

Interesting review has concluded that about one in thirteen adults with ADHD also have comorbid bipolar disorder (Schiweck et al., 2021). Lifetime ADHD has also been shown associated with lifetime bulimia nervosa (Ziobrowski et al., 2018).

5.3 Discussion of work participation

Herein, we examined the prevalence and correlates of work participation in a clinical sample of adults with ADHD. A total of 59.7% of the 813 included participants had work as their main source of income at the time of the assessment. Our results indicated an association between work participation and being male, having married or cohabitating status, living with children, having higher levels of education, and not having a history of major depression. In addition, IQ was significantly associated with work participation in an unadjusted analysis; however, this association did not persist after adjustment for other covariates. We identified no significant associations between work participation and age, ADHD subtype, or total ADHD symptom severity.

The work participation rate of nearly 60% observed herein exceeded that reported in other clinical samples of Norwegian adults with ADHD (Halmøy et al., 2009; Gjervan et al., 2012; Fredriksen et al., 2014). The higher employment rates in our study might have been related to our sample of patients attending a private ADHD clinic, whose socioeconomic status and wealth might have exceeded those of patients referred to public health services, on average. Furthermore, employment can be both a cause and a consequence of socioeconomic differences. The relatively high employment rates observed herein might also have reflected an increased awareness regarding ADHD in adults, thus resulting in more well-functioning patients receiving an ADHD diagnosis.

In this study, the work participation rate was lower than the 70–80% in the general Norwegian population, as reported by Statistics Norway (SSB, 2016), in agreement with. This is in line with the ADHD's definition as a disorder causing impairment in several domains of life (Kooij, et al., 2010; Murphy & Barkley, 1996). Our finding that the employment rate was higher in men (63.7%) compared to women (59.7%) has also been shown in other studies on adult ADHD (Halmøy et al., 2009; Fredriksen et al., 2014) and may reflect ordinary gender differences seen in the general population (SSB, 2016).

Our results indicated that social relationships—such as those in people who are married, cohabitating, or living with children—can provide stability or support that facilitates work participation. These results are consistent with previous findings indicating that perceived support and positive attitudes from family members and the social environment are important predictors of work outcomes (Holwerda et al., 2013). Alternatively, employment may increase income and socioeconomic status, thus providing opportunities for a successful family life; in addition, social or individual characteristics might facilitate both family and work participation. For example, adults with ADHD tend to experience greater family instability over time than adults without ADHD (Murphey and Barkley, 1996; Jaber et al., 2015). Therefore, some ADHD related features may diminish participation in both work and family life.

In our sample, we observed higher levels of education achievement compared to the general population (SSB, 2016), in contrast to findings from other studies of adult ADHD (Barkley et al., 2006; Ebejer et al., 2012; Küpper et al., 2012). This result might have been related to the high socioeconomic status of our cohort attending a private ADHD clinic. On the basis of current evidence, ADHD appears to place people at an educational and vocational disadvantage throughout the life course (Mannuzza et al., 1993, Barkley et al., 2006).

Accordingly, our within-sample analyses indicated that education was associated with work participation, thereby confirming a relationship between education and work ability (Monteiro et al., 2006).

According to some studies, educational attainment may serve as a proxy for IQ, because people with higher IQ tend to acquire more years of education (Batty et al., 2007). However, we observed that the relationship between education and work participation was independent of IQ. Moreover, IQ was not strongly associated with employment after adjustment for other covariates. Although our IQ assessment was limited to a subsample of participants, our results nonetheless suggested that factors beyond intelligence more strongly influence educational attainment among people with ADHD, and that level of intelligence is not a requisite for work participation. We observed no associations between ADHD subtypes or symptom severity and work participation, and this was unexpected, given the evidence-based paradigm in which ADHD results in lower work performance (Mannuzza et al., 1993; Brook et al., 2013; Shifrin et al., 2010).

ADHD symptoms may affect people's attaining education or obtaining and keeping a job, because of a lack of concentration, or interference from hyperactivity and impulsivity (Barkley et al., 2006; Fredriksen et al., 2014). Because ADHD is a dimensional diagnosis ranging from mild to severe (Swanson et al., 2012), a dose-response relationship between symptom severity and work ability is conceivable. However, the presence or absence of ADHD may have a stronger influence on employment status than the differences in symptom severity among patients with clinical ADHD.

5.4 Discussion of substance use disorders

In our clinical adult ADHD sample, we observed a 12-month prevalence of 5.3% for Alcohol Use Disorder (AUD) and 13.7% for Drug Use Disorder (DUD), and the lifetime prevalence was 12.0% for AUD and 27.7% for DUD. All prevalence rates were higher for men compared to women.

The 12-month prevalence of AUD in our sample was like the general population prevalence reported both in Norway and USA (Grant et al., 2015; Rehm et al., 2005; Bratberg et al., 2016). In contrast, the 12-month prevalence of DUD in our sample was considerably higher than the general DUD prevalence rates of 3.9% reported in the USA (Grant et al., 2016) and 3.0% in Europe (Rehm et al., 2005). A similar prevalence pattern was found for lifetime AUD and DUD. While the lifetime prevalence of AUD in our study was lower than

in the general Norwegian or USA population (Grant et al., 2015; Rehm et al., 2005; Bratberg et al., 2016). The lifetime prevalence of DUD was in our study considerably higher than what has been found in the Norwegian population (Grant et al., 2016; Kendler et al., 2006)

Our findings demonstrate the need to distinguish between the two types of Substance Use Disorders (SUD) in the understanding of patients with ADHD. The findings that DUD, and not AUD, was far more prevalent compared to the general population, as well as our findings that DUD, in contrast to AUD, was associated with emotional dysregulation and ADHD symptoms severity, questions the previous statement that ADHD is associated with SUD in general (Vogel et al., 2016; Fatséas et al., 2016) or that the ADHD symptoms severity is associated with high risk for all SUD outcomes (Capusan et al., 2016). According to our findings, there appears to be significant differences between the risk of AUD and DUD in adults with ADHD, at least in our Norwegian outpatient sample.

Several factors may help to explain this. First, we know that genome wide association studies have shown strong genetic correlations between ADHD and DUD (Demontis et al., 2019; Wang et al., 2017), while some genetic factors that contributing to the risk of developing AUD are actually negatively correlated with ADHD (Sanchez-Roige et al., 2019). Second, there may be some shared environmental risk factors or determinants for ADHD and DUD (Wang et al., 2017) for example maternal DUD (Thapar et al., 2007). Third, drug dependence among ADHD people, especially the misuse of amphetamine and cannabis, has been suggested to be a result of self-medication related to the ADHD symptoms (Wilens 2004; Wilens et al., 2007; Brandt et al., 2018). This corresponds to the fact that amphetamine and cannabis were the preferred drugs for drug abuse in our study.

Higher prevalence rates of AUD and DUD in men compared to women in our study are in accordance with gender differences in the general population (Grant et al., 2015; Rehm et al., 2005; Bratberg et al., 2016; Grant et al., 2016). In line with other researchers, we found that women compared to men reported higher levels of hyperactivity-impulsivity (Vildalen et al., 2019) and emotional dysregulation (Robison et al., 2008).

Our observation that DUD was associated with of emotional dysregulation is consistent with findings that higher levels of emotional dysregulation in general increases the risk of developing and maintaining drug use addiction (Cheetham et al., 2010). DUD typically appears later in life compared to ADHD and ED, suggesting that DUD is modified by ADHD and ED, rather than vice versa. On the other hand, it is possible that DUD may reinforce the symptoms of both ADHD and emotional dysregulation in adults with ADHD.

5.5 Discussion of criminal conviction

Our study revealed a high incidence of crime among adult ADHD patients. The 11.7% and 24.5% life-time prevalence rates of criminal conviction (CC) in female and male ADHD patients respectively, were considerably higher than the correspondingly 1% and 5% rates for women and men in the general Norwegian population (Skardhamar, 2014). High risk of crime in people with ADHD is also known from other Scandinavian countries with relatively low incidences of crime in the general population (Lichtenstein et al 2012; Dalsgaard et al 2013).

The two or threefold higher risk of criminal conviction among men versus women is in line with other studies of ADHD patients (Dalsgaard et al 2013, Silva et al 2014, Knecht et al 2015). The ratio is similar to that in the general population (Skardhamar, 2014; Walker & Maddan, 2016), which indicates that gender differences are not affected by ADHD.

There are close links between CC and measures of social characteristics and alcohol and drug use disorder. The challenge with these measures is determining the direction of causality, and therefore, the direct effect of, for example, alcohol and drug use disorder is difficult to interpret since they could be both a cause and a consequence of CC, or they could both have a common underlying risk factor.

The finding that criminal conviction was associated with the severity of hyperactivity-impulsivity symptoms is in line with several studies that have shown associations between the severity of ADHD symptoms and different aspects of antisocial behaviour (Gudjonsson et al., 2016; Gudjonsson et al., 2019, Gudjonsson et al., 2013, Gonzalez et al., 2016, Thapar et al., 2006, Storebø et al., 2016). These findings are also consistent with longitudinal studies of children with ADHD showing that the severity of hyperactivity-impulsivity was associated with later occurrence of criminal conviction (Dalsgaard et al., 2013, Pingault et al., 2013). It is likely that restlessness and impulsivity that are part of the hyperactive-impulsive symptoms may result in less well-considered behavior that may also include violation of law. It is also possible that criminal acts by people with hyperactive-impulsive symptoms are more due to sensation and novelty seeking (Donfrancesco et al., 2015, Mann et al., 2017) and less planned and proactive and that people with ADHD are therefore more likely to be convicted (Young, 2007).

With this aspect in mind, it seems meaningful to address the severity of ADHD as emphasized in the DSM-5, as opposed to categorizing ADHD by sub-type as suggested in the DSM-IV. The strong association between criminal conviction and hyperactive-impulsive

severity also underlines the importance of treating ADHD as a dimensional diagnosis and expecting more antisocial behavior in patients presenting with high levels of hyperactive-impulsive symptoms.

In our sample criminal conviction was associated with the severity of emotional dysregulation, independent of hyperactive-impulsive severity. We suggest that knowledge on emotional dysregulation does add significantly to the understanding of criminal conviction in people with ADHD.

First, emotional dysregulation is a common feature in ADHD, even though not being part of the diagnostic criteria (Aldao et al., 2016, Shaw et al., 2014, Connor et al., 2010, Landaas et al., 2012, Barkley, 2010, Barkley & Fischer 2010, Surman et al., 2011, Surman et al., 2013; Retz et al., 2012, Corbisiero et al., 2017, Hirsch et al., 2018), and it is closely related to ADHD and ADHD severity (Hirsch et al., 2018).

Second, emotional dysregulation contributes significantly to general impairments in patients with ADHD (Faraone et al 2019) and has an independent effect on general social problems associated with ADHD (Surman et al., 2013, Musser et al., 2013).

Third, aggression in childhood has been found to predict criminality later in life (Pingault et al., 2013), and personality traits of negative emotionality have for a long time been linked to criminal activity (Krueger et al., 1994).

Adding emotional dysregulation severity to the concept of ADHD is in line with Reimherr et al., who emphasize a two-factor solution for ADHD subgroups, with a presentation consisting solely of inattention and a more comprehensive hyperactivity-impulsivity-emotional dysregulation presentation (Reimherr et al., 2020).

We found a strong relationship between all background variables and criminal conviction. The association between low education and criminal conviction is notable since people with ADHD have lower levels of education than the general population (Ebejer et al., 2012; Küpper et al., 2012; Barkley et al., 2006). Additionally, drug use disorder was correlated with criminal conviction, which is worth noting since ADHD patients have higher incidences of drug use than the general population (Gudjonsson et al. 2014; Dalsgaard et al., 2014; Von Polier et al., 2012; Crunelle et al., 2018; Anker, Haavik & Heir, 2020).

Several mechanisms may underlie the relationship between crime and substance use disorders. Although substance use and addiction can reasonably be associated with crime, criminal activity may expose people to intoxicants and drugs. In addition, common underlying factors may co-ordinately increase the risk of both substance use and crime. Because we only

had data on the lifetime prevalences of both substance use and criminal convictions, and did not have any hypotheses pertaining to causality, we did not adjust for substance use in our regression model.

Early identification of ADHD and disruptive behaviour, and subsequent multimodal interventions might diminish the risk of a criminal trajectory. Facilitating higher educational attainment and employment, and avoidance of drug use is also likely to aid in preventing criminal conviction among people with ADHD.

5.6 Discussion of WAIS test – verbal working memory and processing speed

In our study we found that the correlations between the psychometric WAIS tests of verbal working memory and processing speed and the attention deficits severity and emotional dysregulation severity, were weak ($R^2 < .1$) and they were mostly not significant. Only processing speed in our sample was associated with severity of attention deficits ($b = 0.056$, $p = 0.003$). The psychometric index scores for verbal working memory (WMI) and processing speed (PSI) in WAIS-III seem therefore to have limited utility as severity indicators of inattention and emotional dysregulation in adults with ADHD.

We found a mean FSIQ score of 103.1 which is just above the general population mean score, indicating good cognitive function in our sample. This finding is contrary to a previous study that has shown that ADHD patients have lower FSIQ scores compared to the population-based norms (Bridgett & Walker, 2006), and this primarily due to lower scores on the WMI and PSI (Harrison, DeLisle, & Parker, 2008; Iverson, Lange, Viljoen, & Brink, 2006; Theiling & Petermann, 2014; Wechsler, Coalson, & Raiford, 2008). There has been a previous discussion regarding adults with ADHD to perform differently from normal controls on the FSIQ (Faraone & Biederman, 2005; Nigg et al., 2005), but our findings do confirmed normal FSIQ mean score and range, at least in this sample of adults with ADHD.

We found significant average lower scores of both WMI and PSI compared to the FSIQ scores. This is in line with findings reported elsewhere in the literature (Iverson et al., 2006; Harrison et al., 2008; Theiling & Petermann, 2014; Wechsler et al., 2008).

We found that verbal working memory was not associated with the severity of attention deficits in an adjusted model. This is in line with also other studies, which have found only weak correlations between working memory scores and inattentive self-reports scores in people with ADHD (Barkley & Murphy, 2011). This underlines the finding that self-

reported symptom severity measures in adult ADHD patients do not necessarily correlate with objective psychometric performance tests (Woods et al., 2002) and correlate only weakly with WAIS performance tests (Theiling, Petermann, & Daseking, 2013). Other researchers have found that ADHD inattentive symptom severity correlated with working memory (Alderson et al., 2013; Brydges, Ozolnieks, & Roberts, 2017), but the correlations between several working memory tests and self-reported inattentive rating scales are weak and mostly not significant (Barkley & Murphy, 2011). These findings indicate that the importance of working memory deficits in ADHD is consistent and do persists into adulthood but methodological variability may to some extent explain why working memory deficits have not been uniformly detected (Alderson et al., 2013; Kasper, Alderson, & Hudec, 2012).

According to Baddeley's definition of working memory, there are two modality-specific components; a phonological loop known as verbal working memory and a visuospatial sketchpad (Baddeley et al., 1999; Baddeley & Hitch 2001). Earlier researchers have found attention deficits to be more closely tied to the visuospatial component than to the phonological loop (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; Rapport et al., 2008; Rhodes et al., 2012), which we have not tested in our sample and is not part of the WAIS test battery.

The severity of attention deficits was not associated with verbal working memory (the phonological loop), as measured by the WMI in WAIS, also after adjusting for covariates. This is in line with previous studies that have found measures of attention deficits in ADHD unrelated to verbal working memory (Martinussen et al., 2005). However, other studies have found verbal working memory to be an important domain of cognitive dysfunction in ADHD (Ramos, Hamdan, & Machado, 2019).

In our sample we found that verbal working memory (WMI) correlated with 4 out of 9 inattentive items (ASRS), which underscores the fact that the WMI captures only a part of attention deficits, namely, the 'verbal working memory deficit'. Verbal working memory is understood as the temporary maintenance of verbal information, an immediate form of memory used to transform verbal information, such as speech, into meaning (Caplan & Waters, 1999). A person with impaired verbal working memory might experience the following difficulty: 'I hear what you say, but I don't understand what you mean'. A specific question to assess this would be: *Do you often have difficulties understanding what people say? Do you often misinterpret what other people say? Do you often have difficulties interpreting the meaning of a sentence spoken to you? Do other people often comment that*

you have not understood their verbal intention or sentence? These suggested questions would enable clinicians to better understand specific parts of the practical difficulties involved in a verbal working memory deficit, and these suggested questions are slightly different from the 4 verbal attention deficit items in the DSM (ASRS, Table 1, page 14).

The severity of attention deficits was in our sample associated with decreased scores of processing speed, measured as the processing speed index (PSI). This is in line with other studies (Barkley & Murphy, 2011; Schweiger, Abramovitch, Doniger, & Simon, 2007; Shanahan et al., 2006). Impaired PSI has been found to correlate with inattention in children with ADHD (Kubo et al., 2018; Thaler et al., 2013; Yang et al., 2013; Jacobson, Geist, & Mahone, 2018). Our finding is in line with also other studies that have shown adults with ADHD to have significant reductions in processing speed, which has been reflected in low PSI scores on the WAIS-IV (Wechsler et al., 2008). Other studies have not found lower processing speed scores to associate with ADHD symptom severity (Brydges et al., 2017). Impaired processing speed has been reported to be only weakly correlated with self-reported attention deficit ratings given by adults with ADHD (Barkley & Murphy, 2011).

The PSI correlated with 4 out of 9 items pertaining to attention deficits in our sample, which underscores that the processing speed index captures only a part of attention deficits in ADHD, namely the *'processing speed deficit'*. Processing speed is known as the pace at which you take in information, make sense of it, and begin to respond (Horning & Davis, 2012). We found that the mean processing speed was significantly slower compared to the mean FSIQ score. Questions that could solicit information about processing speed would be: *How often do you have difficulties starting boring tasks you should have done? How often is it difficult to stay on the right track for your boring tasks? How often do you miss meeting the goal of your boring tasks?* These questions are also slightly different from the 4 original DSM items (or ASRS items 1-4 and 7-11).

Emotional dysregulation was not associated with verbal working memory measured by the WMI score, this after adjusting for covariates, in our study. This contrasts with only one previous study finding deficits in verbal working memory associated with the severity of parent-rated emotional dysregulation in ADHD children (Uderman, 2015); however, other studies have not found such association in adults with ADHD (Gisbert, Vilar et al., 2019; Surman et al., 2015). In our sample, both depression and female sex were significantly associated with emotional dysregulation. This may to some extents have affected the adjusted regression analysis. Additionally, applying the Bonferroni correction considering differences

significant if $p < .025$ favoured a non-significant result. In an unadjusted model we found that emotional dysregulation was associated with both the WMI ($B = .08$, 95% CI: 0.12 to 0.040, $p < .001$, $R^2 = .035$) and PSI ($B = .058$, 95% CI: 0.10 to 0.016 $p = .007$, $R^2 = .017$). There were small correlations between emotional dysregulation and verbal working memory and processing speed, but causal relations were difficult to assess.

Verbal working memory impairment is recognized as an important domain of cognitive dysfunction in ADHD (Moore et al., 2006). Since verbal working memory tasks involve the ability to recall language perception and production (Acheson & MacDonald, 2009), decreased scores for verbal working memory may therefore be tied to impulsive and aggressive verbal behaviour (Kockler & Stanford, 2008). Our finding underscores these findings that aggression, as defined in emotional dysregulation as anger, is linked to deficits in verbal working memory.

Lower scores of executive function have been linked to physical aggression in boys (Seguin et al., 1995), and poorer verbal working memory storage in children can be associated with greater rejection from peers (McQuade et al., 2013). The association between high levels of aggression and low levels of verbal working memory has been seen in studies of general adult population (Colby, 2008). A new goal for verbal working memory training, may be a reduction in emotional dysregulation. With lower verbal working memory capacity compared to their FSIQ score, these people may not comprehend all relevant arguments in a verbal discussion and may therefore misunderstand, misinterpret, or misjudge more easily. Misunderstanding is a main source of anger (Lochman et al., 2010). If so, this may encourage clinicians to try verbal working memory training as an additional therapeutic approach to achieve better emotional regulation in patients with ADHD, although anger regulation should still be treated directly.

In our sample, the items of emotional dysregulation in DESR scale correlated with both verbal working memory (WMI) and processing speed (PSI), with correlations observed for 7 out of 8 items on the DESR scale. The relationship between anger and cognitive distortions (Chereji et al., 2012) and the frequencies of both the expression of anger and cognitive distortion has by other researchers been linked to decreased executive functioning (Persampiere et al., 2014). Explosive anger, labelled emotional dysregulation by Barkley, has been understood as a distortion and a disabling feature of ADHD (Bunford et al., 2018; Skirrow & Asherson, 2013).

5.7 Methodological discussion

The strengths of the study include a naturalistic design with inclusion of a large number of participants over several years referred for examination and treatment of ADHD. All individuals who met the ADHD criteria were asked to participate in the study and there were no exclusion criteria. The rate of written consent and the number of participants were high.

The inclusion of patients attending a private and not state-funded ADHD clinic questions the representativeness of the study sample for the adult population with ADHD in general. They may be less impaired compared to patients in a public outpatient clinics or hospitals. Also, the prevalence of comorbidity may not be representative for the total ADHD patient population. However, we assume that differences in the sample selection may primarily affect the prevalence rates, and to a lesser extent the associations (Nohr & Olsen, 2013; Rothman et al., 2013). The associations between prevalence scores and ADHD or emotional dysregulation severity should therefore be considered in a more general context.

Conclusions about causality cannot be made because of the cross-sectional design of this study. Longitudinal studies are therefore needed to explore the nature of the association between education, work participation, criminality and psychiatric comorbidity in people with ADHD.

The fact that all participants came to assessment for possible ADHD, and assessed by the same psychiatrist, may have given a bias towards giving an ADHD diagnosis and also certain comorbidities. This has not been controlled for. The fact that assessment rely on the honesty of the patient reporting the truth about their functioning has to some extent been controlled for by neuropsychological assessment.

In our study we restricted our examination to 16 axis I DSM-IV diagnosis that are common in the general population (Sheehan et al., 1998) and have not considered other comorbid psychiatric disorders that may exist in people with adult ADHD. For example, we have no information about personality disorders, and we did not collect data on income and wealth. Such data might have indicated whether it is the work in itself, or what it cause by financial benefits that is related to mental health.

We found higher rates of work participation among our participants than has been found in other clinical samples of Norwegian adults with ADHD (Halmøy et al., 2009; Gjervan et al., 2012; Fredriksen et al., 2014). The prevalence of alcohol and drug morbidity may not be representative of the total ADHD patient population. Still, the reported

comorbidity prevalence rates in our study were similar to reported prevalences for the Norwegian population, register study (Solberg et al., 2018).

Criminal conviction was based on self-report which may have resulted in underreport. The prevalence rates of criminality in this population may not be representative of the total ADHD patient population, but differences in our sample selection may primarily affect prevalences and to a lesser extent their associations (Nohr & Olsen, 2013; Rothman et al., 2013). The associations with criminal conviction should therefore be more generalizable.

We assume ADHD and emotional dysregulation are traits developing in childhood before criminal minimum age, which is 15 years of age in Norway, and therefore may give us indication of a direction of causality.

The use of the WAIS-III compared to the newer version WAIS-IV is a possible weakness of this study. It has been reported that the WAIS-IV should provide superior measurement and scoring, and even a better structural model to measure the FSIQ compared to the WAIS-III (And & Benson, 2013). Nevertheless, working memory is still tested only in the auditory modality (Egeland, 2015), and both the WAIS-III and WAIS-IV detect working memory and processing speed in adults, which suggests that the identification of deficits with both versions of the WAIS remains robust (Wechsler et al., 2008). Altogether, the WAIS-IV is better and newer but not a different assessment instrument than the WAIS-III. We therefore believe the statistical results reported in this article would not have been radically different using WAIS-IV.

5.8 Clinical Implications

ADHD research is often done in state-funded public clinics. In our study we have shown that even in a private clinic there are high rates of psychiatric comorbidity, drug-abuse, criminality, and lower rates of work-participation compared with the general population. This underscores the personal cost of having an undiscovered and untreated ADHD and should alert clinicians to recognise the struggle of this patient group.

Clinicians should be aware of high rates of comorbid psychiatric disorders in adults with ADHD. Symptoms of comorbid psychiatric disorders may complicate the examination of ADHD or the evaluation of treatment. It may also be complicated to detect and treat comorbid psychiatric disorders because symptoms are obscured by ADHD symptomatology. It has been suggested that people with ADHD should be screened for depression, anxiety, and substance

use (Ng 2017). Another suggestion is that clinicians should consider ADHD evaluation and treatment as part of the management of substance use disorders (Capusan et al., 2016).

There is convincing evidence that social capital is protective against developing common mental disorders (Ehsan & De Silva 2015), which may be equally valid for people with ADHD. People with ADHD report inferior educational and occupational attainment (Halmøy et al., 2009, Ebejer et al., 2012; Kuppe et al., 2012). In the present sample of ADHD patients 60% had work compared to 80-90% of adults in the Norwegian general population (Statistics Norway; SSB 2018). In other Norwegian samples of adult ADHD patients, work participation has been even lower, ranging from 24% (Halmøy et al., 2009) to 44% (Fredriksen et al., 2014). Thus, there is reasonable evidence to implement and evaluate therapeutic interventions to facilitate education and work participation in people with ADHD. The effectiveness of such intervention in preventing comorbid mental disorders should be evaluated in longitudinal studies.

Access to employment has been reported to increase status, social power, and economic independence (Ross & Mirowsky, 1995), and to be important for mental health (WHO, 2012). Thus, a major goal should be to provide people with ADHD with support in gaining employment and continuing to work. A key outstanding question pertains to whether treatments aiming to decrease ADHD symptoms in adults might facilitate work performance (Kessler et al., 2005). The lack of correlation between total ADHD severity scores and work participation observed herein does not support this possibility, although successful treatment of adult ADHD has been linked to substantially improved cognition and behavior (Schweitzer et al., 2004; Turner et al., 2004).

However, ADHD may have causal effects on work participation via more proximate causes, such as social skills, education, or comorbid mental disorders. Such correlates, despite their high likelihood of being affected by ADHD, show stronger associations with work participation than do total ADHD symptom severity or the ADHD clinical subtype. These observations indicated a need for appropriate follow-up and treatment of ADHD from childhood through adolescence and adulthood, to facilitate educational attainment and social affiliation while preventing comorbid psychiatric disorders. Interventions focusing on positive resources may be as important as mitigating ADHD symptoms.

The prevalence of lifetime depression in our cohort far exceeded that expected in the general population (Kessler et al., 1994), and these results are also in accordance with others (Biederman, Ball et al., 2008). Comorbid depression is an important target of prevention and

intervention, given that more extensive ADHD treatment has been associated with resilience to depression in adults (Oddo et al., 2018).

A comorbid drug use disorder should be considered in adult ADHD patients, particularly in males and among individuals with high levels of hyperactive-impulsive ADHD core symptoms or emotional dysregulation. The causal mechanisms of the relationship between ADHD and drug use disorder are not known, but self-medication for hyperactivity-impulsivity and emotional dysregulation is one possibility. Thus, early recognition of ADHD and targeted therapeutic interventions may be necessary to prevent the possible negative consequences of ADHD.

Because criminal behaviour is common in adults with ADHD, research efforts to prevent criminal activity in people with ADHD must be expanded. Given that greater severity of hyperactivity-impulsivity symptoms and emotional dysregulation have been associated with criminal conviction, clinical manifestations must be treated carefully. In early childhood through adulthood, professionals with specific knowledge of the ADHD treatment and behavioural interactions should focus on early identification, as well as biological and psychosocial approaches to prevent externalizing behaviour. Furthermore, targeted interventions should examine the preventive effects of academic achievement and higher education in adolescents with ADHD. Such interventions may be crucial in helping people with ADHD avoid illegal drug use, antisocial behaviour, and criminal activity.

The symptoms of attention deficits are related to the subjective experience of being inattentive and are weakly associated with the objective finding of processing speed deficits. Emotional dysregulation is a subjective awareness of experiencing explosive anger but was in our study not associated with verbal working memory (WMI) nor processing speed (PSI). In our adult ADHD sample, we found typical lower scores compared to FSIQ in the WMI and PSI, but only the PSI was associated with attention deficits, and the power of this association was limited. We believe that objectively tested verbal working memory and processing speed do measure only minor parts of the subjective experience of attention deficits and emotional dysregulation in adults with ADHD.

Extending the WAIS test battery by including measures of visuospatial working memory may possibly make this psychometric WAIS tool more suitable for measuring attention deficits in ADHD. Only weak correlations between items of attention deficit (ASRS subscore) and emotional dysregulation (DESR scale) indicate that the questions in these

questionnaires do not fully reflect measures of verbal working memory and processing speed. Alternative questions may better reflect these parameters.

5.9 Conclusions

Compared to general population, adult ADHD was associated with high rates of comorbid psychiatric disorders, irrespective of gender and age. It appears that higher education and work participation were related to lower probability of comorbidity. In our sample IQ was associated with neither comorbidity nor educational level.

In our sample of adults with ADHD 55.3% of the women and 63.7% of the men reported working as their main source of income at the time of inclusion. Occupational outcome in adults with ADHD appears to be more associated with social characteristics and a history of depression, rather than IQ.

The prevalence of Drug Use Disorder in our adult ADHD patients were a much higher than what has been reported in general populations, and this was independently associated with higher symptom levels of both severity of hyperactivity-impulsivity and emotional dysregulation, but not with attention deficit. The prevalence of Alcohol Use Disorder was similar to the general population and showed no association with the severity of ADHD or emotional dysregulation.

The prevalences of criminal conviction were high for both genders compared to the prevalence rates reported in the general population. Criminal conviction was associated with the severity of hyperactivity-impulsivity, as well as emotional dysregulation, which indicates that knowledge on both features contributes to the understanding of criminal conviction in ADHD.

The participants tested in our study got a mean FSIQ score slightly above general normal range, but with the expected typical lower scores in verbal working memory, as tested by the WMI, and processing speed, as tested by the PSI. Only processing speed was associated with attention deficit severity, but the effect size of this association was small. This indicate that the correlations between attention deficit severity and emotional dysregulation severity, and psychometric WAIS tests of verbal working memory and processing speed were weak ($R^2 < .1$) and mostly not significant. The psychometric WMI and PSI seem therefore to have limited utility as objective severity indicators of the subjective attention deficits and emotional dysregulation in adult patients with ADHD.

The conclusion is that even in a private psychiatric clinic adults with ADHD have higher rates of psychiatric comorbidity, drug abuse, criminality, and lower rates of work participation compared with the general population.

6. FUTURE PERSPECTIVES

6.1 Investigation of more associations

Associations between the severity of ADHD and emotional dysregulation, and the frequency of comorbid psychiatric disorders and work participation may be investigated. The results might indicate that these severity scores are both associated with psychiatric comorbidity but not with work participation.

6.2 Longitudinal studies after treatment of ADHD

Long-term longitudinal studies to measure outcomes after diagnostic assessment and treatment of ADHD are lacking.

Longitudinal studies on the prevalence of psychiatric comorbidities after diagnostic assessment and treatment of ADHD will be of great interest. Does treatment of ADHD also have positive effects on psychiatric comorbidities and even educational levels?

A longitudinal study on work participation after diagnostic assessment and treatment of ADHD will be of great interest. Does treatment of ADHD also have positive effects on the prevalence of work participation?

A longitudinal study on drug use disorder after diagnostic assessment and treatment of ADHD will be of great interest. Does treatment of ADHD also have positive effects on the prevalence of drug use disorder?

A longitudinal study on criminality after the diagnostic assessment and treatment of ADHD will be of great interest. Does treatment of ADHD also have positive effects on the prevalence of criminal activity?

A follow up study on neuropsychological measures after diagnostic assessment and treatment of ADHD will be of great interest. Does treatment of ADHD also have positive effects on measures of verbal working memory or processing speed?

6.3 Future perspectives on ADHD aspects and neuropsychological measures

Objective neuropsychological WAIS measures and subjective ADHD questionnaire measures could potentially be adjusted, as suggested in the discussion section (Discussion of WAIS test–working memory and processing speed, pages 46–49).

Expanding the WAIS test battery with not only verbal but also visuospatial working memory tests is proposed. This expansion would be of interest in assessing people with ADHD and would supplement the current tests of only verbal working memory.

ADHD questionnaire items that could solicit information about verbal working memory are proposed (page 47).

ADHD questionnaire items that could solicit information about processing speed are proposed (page 48).

6.4 Future perspectives on emotional dysregulation in ADHD

An ensuing issue after the work in this dissertation is better understanding and defining emotional dysregulation. The DESR questionnaire (Table 2, page 22) of emotional dysregulation used in this dissertation and by several others (Barkley 1997a; Barkley, 2010a; Surman et al., 2013; Biederman, Petty et al., 2008) is somewhat simple. These questionnaire items are similar to the items in several others often used questionnaires, such as The Symptom Checklist (SCL-90) (Derogatis et al., 1976), Wender Utah Rating Scale (WURS) (Ward et al., 1993), Wender-Reimherr Adult Attention Deficit Disorder Scale (WRAADDs), (Wender, 1995), Conners' Adult ADHD Rating Scales (CAARS) (Conners et al., 1999), and Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004). All these questionnaires are essentially based on the same simple items. An emotional dysregulation questionnaire could be developed to provide a more comprehensive questionnaire. To substantiate this new questionnaire, greater understanding of emotional arousal in individuals is necessary.

A reasonable way of examining emotional arousal, according to McRae et al., 2012, is based on a framework in which emotions may be generated in two different ways: a primarily 'bottom-up'/reptilian response to the inherently emotional perceptual properties of a stimulus or a 'top-down'/human stimulus response to the cognitive appraisal of an event.

Bottom-up emotions are elicited largely by perceptions, which need not be accessible to conscious awareness and are often sensory origin, for example, scary noises, visual threats, or other perceptual stimulus of danger. Bottom-up stimulus responses are more reptilian or inherent, and this emotional over-reactivity is associated with neuroticism.

Top-down emotions are elicited largely by cognition, which is associated with linguistically represented appraisals that are usually accessible to conscious awareness, for example thinking of injustice. Top-down emotions are human and cognitive, and related to

narcissistic personality (feelings of self-importance, an excessive craving for admiration, and struggles with empathy) and emotional over-reactivity items.

The questionnaires used in this dissertation and other similar questionnaires do not consider the concepts of bottom-up and top-down generation and regulation of emotions. Therefore, a new questionnaire including these aspects is proposed (Table 3, page 64). The first item group includes excessively rapid bottom-up generation as reptilian, inherent, neuroticism, emotional over-reactivity in response to physical danger, and then emotional (dys)regulation items of this fast overreaction. The second item group includes excessively rapid top-down generation as human, cognitive, narcissistic over-reactivity in response to mental danger or threats, and then emotional (dys)regulation items of this fast overreaction.

Based on clinical experience, I would expect people with higher severity scores of ADHD and emotional dysregulation to score lower on bottom-up items and higher on top-down items. This possibility has yet to be demonstrated.

Table 3. Proposed ADHD Emotional Dysregulation Questionnaire (AEDQ):

Please answer the questions below, rating yourself on each of the criteria shown using the scale on the right side of the page. As you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months.	Never or rarely (0)	Some-times (1)	Often (2)	Very often (3)
Bottom-up: reptilian/inherent/neuroticism/emotional items: over-reactivity in response to physical danger				
Easily frightened when seeing something horrible or scary				
Easily upset/afraid when in physical danger				
Easily feel that real world/life is too challenging/distressing				
Bottom-up: emotional (dys-) regulation items:				
Difficulties in calming down when physically afraid				
Difficulties in thinking clearly when in physical danger				
Difficulties in overcoming traumatic distress in real life				
Top-down: human/cognitive/narcissistic items: over-reactivity in response to mental threats:				
Easily angry when experiencing/exposed to injustice				
Easily upset when understanding/experiencing that people are lying				
Easily angry when feeling violated by others				
Top-down emotional (dys-) regulation items				
Difficulties in thinking of forgiveness when experiencing injustice				
Difficulties in reappraisal when understanding that people are lying				
Difficulties in overcoming/reorienting when feeling violated				

6.5 Psychotherapy of emotional dysregulation

The division of generation of emotions into two parts also has therapeutic implications, because top-down generated emotions are more easily down-regulated by the therapeutic approach of ‘reappraisal’ (norsk: revurdering) than bottom-up generated emotions. Using reappraisal as a therapeutic approach to decrease bottom-up generated emotions may even be counterproductive (McRae et al., 2012).

The results of several fMRI analyses have suggested that reappraisal and emotions generated from top-down stimuli share a core network of prefrontal, temporal, and cingulate regions. This overlap is specific, and no such overlap has been observed between reappraisal and emotions generated in a bottom-up fashion (Otto et al., 2014).

Because the prefrontal cortex plays an important role in both the generation and regulation of emotions (Dixon et al., 2017), and emotional regulation is a complex construct incorporating a balance of both top-down and bottom-up regulatory processes (Cole, et al., 2019), these aspects must be taken into consideration. Emotional self-regulatory failure occurs whenever this balance is tipped, either because of particularly strong impulses or impairment of prefrontal executive function itself (Heatherton & Wagner, 2011). Executive functions from the fronto-parietal circuits mediate control, and brain regions involved in bottom-up processes (e.g., the amygdala, orbitofrontal cortex, and ventral striatum) are all involved in emotional regulation and dysregulation (Lenzi et al., 2018).

Emotional dysregulation is considered a transdiagnostic factor in the development and maintenance of psychopathology (Aldao, et al., 2010; Aldao et al., 2016; Gratz et al., 2015). As a transdiagnostic treatment construct, emotional regulation may therefore be a key target for psychological intervention across multiple forms of psychotherapy (Gratz et al., 2015; Sloan et al., 2017).

- Emotional dysregulation (diagnosis unspecific) is, for example, a common reason for referral to child psychiatry, (particularly girls), wherein emotional regulation difficulties are the referral reason for treatment.
- Training in emotional regulation skills, such as Dialectical Behavior Therapy (DBT) (Hirvikoski et al., 2011; Lopez-Pinar et al., 2018; Philipson et al., 2015; Goodman et al., 2014), may benefit patients with ADHD and aid in the treatment of concurrent disorders characterized by maladaptive regulation of emotions and impulsivity

(Philipsen et al., 2015). Acceptance-based skill acquisition and cognitive reappraisal DBT for children is a newer therapeutic approach in Norway.

- Emotional regulation group therapy (ERGT) for patients with borderline personality disorder (Gratz et al., 2015) has been found to be effective in reducing impulsive behaviour, and its utility among at-risk populations, such as people with ADHD with emotional dysregulation, might be tested.
- Mindfulness training is associated with top-down emotional regulation in the short term and with bottom-up emotional regulation in the long-term (Chiesa et al., 2013).
- Meditation and yoga are intended to help people calm down, reduce stress levels, increase concentration and awareness, and have greater emotional regulation capabilities.

7. REFERENCES

- Acheson DJ & MacDonald MC (2009). Verbal working memory and language production: Common approaches to the serial ordering of verbal information. *Psychological Bulletin*, 135 (1), 50. <https://doi.org/10.1037/a0014411>
- Adler LA, Kessler RC & Spencer T (2003). Adult ADHD self-report scale-v1.1 (ASRS-v1.1) symptom checklist. *New York, NY: World Health Organization*.
- Adler LA, Spencer T, Faraone SV, Kessler RC, Howes MJ, Biederman J. (2006) Validity of Pilot Adult ADHD Self- Report Scale (ASRS) to Rate Adult ADHD Symptoms. *Annals of Clinical Psychiatry*, Volume 18, 2006 - Issue 3 Pages 145-148 DOI: 10.1080/10401230600801077
- Aebi M, Barra S, Bessler C, Steinhausen HC, Walitza S & Plattner B (2016). Oppositional defiant disorder dimensions and subtypes among detained male adolescent offenders. *Journal of child psychology and psychiatry*, 57(6), 729-736. DOI:10.1007/s00787-019-01339-z
- Aldao A, Nolen-Hoeksema S & Schweizer S (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical psychology review*, 30(2), 217-237. DOI: 10.1016/j.cpr.2009.11.004
- Aldao A, Gee DG, De Los Reyes A, & Seager I. (2016). Emotion regulation as a transdiagnostic factor in the development of internalizing and externalizing psychopathology: Current and future directions. *Development and psychopathology*, 28(4pt1), 927-946. <https://doi.org/10.1017/S0954579416000638>
- Alderson RM, Kasper LJ, Hudec KL & Patros CH (2013). Attention-deficit/hyperactivity disorder (ADHD) and working memory in adults: A meta-analytic review. *Neuropsychology*, 27 (3), 287–302. <https://doi.org/10.1037/a0032371>
- Ameringer KJ & Leventhal AM (2013) Associations between attention deficit hyperreactive disorder symptom domains and DSM-IV lifetime substance dependence. *Am J Addiction*, 2013;22:23-32. <https://doi.org/10.1111/j.1521-0391.2013.00325.x>
- Anastopoulos AD, DuPaul GJ, Weyandt LL, Morrissey-Kane E, Sommer JL, Rhoads LH, Murphy KR, Gormley MJ, Gudmundsdottir BG. (2016) Rates and Patterns of Comorbidity Among First-Year College Students With ADHD. *J Clin Child Adolesc Psychol*. 2016 Feb 6:1-12. doi: 10.1080/15374416.2015.1105137
- And TGE & Benson N (2013). Matters of consequence: An empirical investigation of the WAIS- III and WAIS-IV and implications for addressing the Atkins intelligence criterion. *Journal of Forensic Psychology Practice*, 2013(13), 27–48. <https://doi.org/10.1080/15228932.2013.746913>
- Andersen I, Thielen K, Nygaard E, Diderichsen F (2009) Social inequality in the prevalence of depressive disorders. *J Epidemiol Community Health*. 2009; 63:575-81. doi:10.1136/jech.2008.082719

- Andrews G, Henderson S, Hall W (2001) Prevalence, comorbidity, disability and service utilization—overview of the Australian National Health Survey. *Br J Psychiatry* 2001; 178:145–153 DOI: 10.1192/bjp.178.2.145
- Anker E, Bendiksen B & Heir T (2018). Comorbid psychiatric disorders in a clinical sample of adults with ADHD, and associations with education, work, and social characteristics: a cross sectional study *BMJ open*, 8(3), e019700. DOI: 10.1136/bmjopen-2017-019700
- Anker E, Halmøy A & Heir T (2019). Work participation in ADHD and associations with social characteristics, education, lifetime depression, and ADHD symptom severity. *ADHD Attention Deficit and Hyperactivity Disorders*, 11(2), 159-165. DOI: 10.1007/s12402-018-0260-2
- Anker E, Haavik J & Heir T (2020) Alcohol and drug use disorders in adult attention-deficit/hyperactivity disorder: Prevalence and associations with attention-deficit/hyperactivity disorder symptom severity and emotional dysregulation. *World J Psychiatry* 2020 September 19; 10(9): 202-211 DOI: 10.5498/wjp.v10.i9.202
- Anker E, Ginsberg Y & Heir T (2021) Prevalence of criminal convictions in Norwegian adult ADHD outpatients and associations with ADHD symptom severity and emotional dysregulation. *BMC Psychiatry* 21, 226 (2021). DOI: 10.1186/s12888-021-03223-0
- Anker E, Ogrim G & Heir T (2021) Verbal Working Memory and Processing Speed: Correlations with the severity of Attention Deficit and Emotional Dysregulation in Adult ADHD *Journal of Neuropsychology*. DOI: 10.1111/jnp.12260
- APA (1968) DSM-II (Diagnostic and Statistical Manual version II, American Psychiatric Association, 1968
- APA (1980) The DSM-III Diagnostic and Statistical Manual of Mental Disorders, Third Edition. Washington, DC: American Psychiatric Association, 1980
- APA (2004) DSM-IV. Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision. Washington, DC: American Psychiatric Association, 2004
- APA (2013), DSM-5®. Diagnostic and statistical manual of mental disorders, 5th ed. Arlington, VA: American Psychiatric Publishing. Text Revision. Washington DC. 2013 DOI: 10.1176/appi.books.9780890425596.x00
- Archer T, Oscar-Berman M & Blum K (2011) Epigenetics in developmental disorder: ADHD and endophenotypes. *Journal of genetic syndrome & gene therapy*, 2011, 2(104). DOI: 10.4172/2157-7412.1000104
- Ardila A (2007). Normal aging increases cognitive heterogeneity: Analysis of dispersion in WAIS-III scores across age. *Archives of Clinical Neuropsychology*, 22, 1003–1011. <https://doi.org/10.1016/j.acn.2007.08.004>
- Baddeley AD & Hitch G (1974). Working memory. In GH Bower (Ed.), *Psychology of learning and motivation* (Vol. 8, pp. 47–89). New York, NY: Academic Press.
- Baddeley AD & Logie RH (1999). Working memory: A multiple-component model. In A. Miyake, & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28–61). Cambridge, UK: Cambridge University Press. <http://dx.doi.org/10.1080/14640749208401281>

- Baddeley A & Hitch G (2001). In A. Miyake (Ed.), *Working memory in perspective* (pp. 240–260). East Sussex, UK: Psychology Press.
- Baggio S, Fructuoso A, Guimaraes M, Fois E, Golay D, Heller P, ... & Gétaz L (2018). Prevalence of attention deficit hyperactivity disorder in detention settings: a systematic review and meta-analysis. *Frontiers in psychiatry*, 9, 331. DOI: 10.3389/fpsy.2018.00331
- Banaschewski T, Jenzen-Steinmetz C, Brandeis D, Buitelaar JK, Kuntsi J, Poustka L, . . . Asherson P (2012). Neuropsychological correlates of emotional lability in children with ADHD. *J Child Psychol Psychiatry*, 53(11), 1139-1148. doi:10.1111/j.1469-7610.2012.02596.x
- Barkley RA (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121,65–94. [https://doi.org/ 10.1037/0033-2909.121.1.65](https://doi.org/10.1037/0033-2909.121.1.65)
- Barkley RA, Fischer M, Smallish L & Fletcher K (2002). The persistence of attention-deficit/hyperactivity disorder into young adulthood as a function of reporting source and definition of disorder. *Journal of Abnormal Psychology*, 111(2), 279. <https://doi.org/10.1037/0021-843X.111.2.279>
- Barkley RA, Fischer A, Smallish L, Fletcher K. (2004) Young Adult Follow-Up of Hyperactive Children: Antisocial Activities and Drug Use. *J Child Psychol Psychiatry*. 2004 Feb;45(2): 195-211. DOI: 10.1111/j.1469-7610.2004.00214.x
- Barkley RA, Fischer M, Smallish L, Fletcher MAK. (2006) Young Adult Outcome of Hyperactive Children: Adaptive Functioning in Major Life Activities. *J Am Acad Child Adolesc Psychiatry* 2006 Feb; 45 (2):192-202. DOI: 10.1097/01.chi.0000189134.97436.e2
- Barkley RA, Murphy KR, Robison RJ, Reimherr FW, Marchant BK, Kondo D, Coon H, Rosen PJ, Epstein JN. (2010) Deficient emotional self-regulation in adults with Attention deficit Hyperactive Disorder (ADHD): The Relative Contribution of Emotional Impulsiveness and ADHD symptoms to Adaptive Impairment in Major Life Activities. *J ADHD Related Disorders* 2010; 1: 5-28 DOI: 10.1521/adhd.2010.18.4.1
- Barkley RA (2010a). Deficient emotional self-regulation is a core component of ADHD. *Journal of ADHD & Related Disorders*, 1,5–37.
- Barkley RA (2010b). Differential diagnosis of adults with ADHD. *The Journal of Clinical Psychiatry*, 71(07), e17. <https://doi.org/10.4088/JCP.9066tx1c>
- Barkley RA & Fischer M (2010). The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. *Journal of the American Academy of Child & Adolescent Psychiatry*, 49(5), 503-513. <https://doi.org/10.1097/00004583-201005000-00011>
- Barkley RA and Murphy KR (2010). Deficient emotional self-regulation in adults with Attention deficit Hyperactive Disorder (ADHD): The Relative Contribution of Emotional Impulsiveness and ADHD symptoms to Adaptive Impairment in Major Life Activities. *J. ADHD Related Disorders* 2010 vol 1, 5-28 DOI:10.1176/appi.ajp.2010.10081172

- Barkley RA & Murphy KR (2011). The nature of executive function (EF) deficits in daily life activities in adults with ADHD and their relationship to performance on EF tests. *Journal of Psychopathological Behavior Assessment*, 2011, 33. <https://doi.org/10.1007/s10862-011-9217-x>
- Barkley RA (2015). Emotional dysregulation is a core component of ADHD. In R.A. Barkley (Ed.), *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (4th edn). New York: Guilford Press.
- Barkley RA (2016). Recent longitudinal studies of childhood attention-deficit/hyperactivity disorder: Important themes and questions for further research. *J Abnorm Psychol*, 125(2), 248-255. DOI: 10.1037/abn0000125
- Barrett LF & Bliss-Moreau E (2009). Affect as a Psychological Primitive. *Adv Exp Soc Psychol*, 41, 167-218. doi:10.1016/s0065-2601(08)00404-8
- Batty GD, Deary IJ, Macintyre S. (2007) Childhood IQ in relation to risk factors for premature mortality in middle-aged persons: the Aberdeen Children of the 1950s study. *J Epidemiol Comm Health* 2007; 61:241-247. DOI: 10.1136/jech.2006.048215
- Baumiester H & Harter M. (2007) Prevalence of mental disorders based on general population surveys. *Soc Psychiatry Psychiatr Epidemiol* 2007; 42:537-546. DOI:10.1007/s00127-007-0204-1
- Bendiksen B (2016) Symptoms of Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder and Conduct Disorder in preschool children: comorbidity patterns, functional impairment and perinatal maternal risk factors. (Doctoral dissertation), Oslo University, 2016.
- Biederman J, Monuteaux M, Mick E, Spencer T, Wilens T, Silva J, Snyder L, Faraone SV. (2006) Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. *Psychol Med* 2006; 36:167–179. DOI:10.1017/S0033291705006410
- Biederman J, Petty CR, Fried R, Black S, Faneuil A, Doyle AE, ... Faraone SV (2008). Discordance between psychometric testing and questionnaire-based definitions of executive function deficits in individuals with ADHD. *Journal of Attention Disorders*, 12(1), 92–102. <https://doi.org/10.1177/1087054707305111>
- Biederman J, Ball SW, Monuteaux MC, Mick E, Spencer TJ, McCreary M, Cote M, Faraone S (2008) New Insights into the Comorbidity between ADHD and Major Depression in Adolescent and Young Adult Females. V *Journal of the American Academy of Child and Adolescent Psychiatry*, April 2008, Vol.47(4), pp.426-34 doi:10.1089/cap.2008.032
- Biederman J, Spencer TJ, Petty C, Hyder LL, O'Connor KB, Surman CBH, Faraone SV (2012) Longitudinal course of deficient emotional self-regulation CBCL profile in youth with ADHD: prospective controlled study. *Neuropsychiatric Disease and Treatment*, 8, 267. <https://doi.org/10.2147/NDT.S29670>
- Biederman J, DiSalvo M, Woodworth KY, Fried R, Uchida M, Biederman I, ... & Faraone SV (2020). Toward operationalizing deficient emotional self-regulation in newly referred adults with ADHD: A receiver operator characteristic curve analysis. *European Psychiatry*, 63(1). DOI: 10.1192/j.eurpsy.2019.11

- Bijl RV, Ravelli A, Zessen G van. (1998) Prevalence of psychiatric disorder in the general population: results of the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Soc Psychiatry Psychiatr Epidemiol* 1998; 33:587–595
<https://doi.org/10.1007/s001270050098>
- Bjorkquist OA, Fryer SL, Reiss AL, Mattson SN & Riley EP (2010). Cingulate gyrus morphology in children and adolescents with fetal alcohol spectrum disorders. *Psychiatry Research: Neuroimaging*, 181(2), 101-107.
<https://doi.org/10.1007/s00221-016-4732-3>
- Bondevik H, Madsen O & Solbrække KN (red.) (2017) Snart er vi alle pasienter, Medikalisering i Norden, Oslo, 2017: Spartacus forlag/Scandinavian Academic Press
- Bratberg GH, Wilsnack SC, Wilsnack R, Haugland SH, Krokstad S, Sund ER & Bjørngaard JH: (2016) Gender differences and gender convergence in alcohol use over the past three decades (1984-2008), The HUNT Study, Norway. *BMC Public Health*. 2016 Aug 5;16:723. DOI: 10.1186/s12889-016-3384-3
- Brandt A, Rehm J & Lev-Ran S (2018) Clinical Correlates of Cannabis Use Among Individuals With Attention Deficit Hyperactivity Disorder. *The Journal of nervous and mental disease*, 2018. 206(9), 726-732. DOI: 10.1097/NMD.0000000000000877
- Brewin CR, Cloitre M, Hyland P, Shevlin M, Maercker A, Bryant RA, et al. (2017). "A review of current evidence regarding the ICD-11 proposals for diagnosing PTSD and complex PTSD" (PDF). *Clinical Psychology Review*. 58: 1–15. DOI: 10.1016/j.cpr.2017.09.001.
- Bridgett DJ & Walker ME (2006). Intellectual functioning in adults with ADHD: A meta-analytic examination of full scale IQ differences between adults with and without ADHD. *Psychological Assessment*, 18(1), 1–14. <https://doi.org/10.1037/1040-3590.18.1.1>
- Brody LR (1997). Gender and emotion: Beyond stereotypes. 53(2), 369-393.
<https://doi.org/10.1111/j.1540-4560.1997.tb02448.x>
- Brook JS, Brook DW, Zhang C, Seltzer N, and Finch SJ. (2013) Adolescent ADHD and Adult Physical and Mental Health, Work Performance, and Financial Stress. *PEDIATRICS* Volume 131, No 1, January
- Brydges CR, Ozolnieks KL & Roberts G (2017). Working memory—not processing speed—mediates fluid intelligence deficits associated with attention deficit/hyperactivity disorder symptoms. *Journal of Neuropsychology*, 11(3), 362–377.
<https://doi.org/10.1111/jnp.1209620>
- Bunford N, Evans SW & Langberg JM (2018). Emotion dysregulation is associated with social impairment among young adolescents with ADHD. *Journal of Attention Disorders*, 22(1), 66– 82. <https://doi.org/10.1177/1087054714527793>
- Bush G (2010). Attention-deficit/hyperactivity disorder and attention networks. *Neuropsychopharmacology*, 35(1), 278–300. <https://doi.org/10.1038/npp.2009.120>
- Butzbach M, Fuermaier AB, Aschenbrenner S, Weisbrod M, Tucha L & Tucha O (2019). Basic processes as foundations of cognitive impairment in adult ADHD. *Journal of Neural Transmission*, 126, 1347–1362. <https://doi.org/10.1007/s00702-019-02049-1>

- Bøe T, Øverland S, Lundervold AJ, Hysing M. (2012) Socioeconomic status and children's mental health: results from the Bergen Child Study. *Soc Psychiatry. Psychiatry Epidemiol.* 2012 Oct;47(10):1557-66. doi: 10.1007/s00127-011-0462-9
- Camara B, Padoin C & Bolea B (2021) Relationship between sex hormones, reproductive stages and ADHD: a systematic review. *Arch Womens Ment Health* <https://doi.org/10.1007/s00737-021-01181-w>
- Caplan D & Waters GS (1999). Verbal working memory and sentence comprehension. *Behavioral and Brain Sciences*, 22(1), 77–94. DOI: 10.1017/S0140525X99001788
- Capusan AJ, Bendtsen P, Marteinsdottir I, Larsson H (2016) Comorbidity of Adult ADHD and Its Subtypes with Substance Use Disorder in a Large Population-Based Epidemiological Study. *Journal of Attention Disorders*, 02/02/2016 DOI:10.1177/1087054715626511
- Caye A, Spadini AV, Karam RG, Grevet EH, Rovaris DL, Bau CH, ... & Kieling C (2016). Predictors of persistence of ADHD into adulthood: a systematic review of the literature and meta-analysis. *European Child & Adolescent Psychiatry*, 25(11), 1151-1159. DOI:10.1007/s00787-016-0831-8
- Chang C, Kaczurkin AN, McLean CP & Foa EB (2018). Emotion regulation is associated with PTSD and depression among female adolescent survivors of childhood sexual abuse. *Psychol Trauma*, 10(3), 319-326. <https://doi.org/10.1037/tra0000306>
- Charach A, Yeung E, Climans T, Lillie E. (2011) Childhood attention-deficit/hyperactivity disorder and future substance use disorders: comparative meta-analyses. *J Am Acad Child Adolesc Psychiatry* 2011; 50: 9–21 DOI: 10.1016/j.jaac.2010.09.019
- Cheetham A, Allen NB, Yücel M, Lubman DI. (2010) The role of affective dysregulation in drug addiction. *Clinical Psychology Rev.* 2010,30,6,621-34 DOI:10.1016/j.cpr.2010.04.005
- Chereji SV, Pintea S & David D (2012). The relationship of anger and cognitive distortions with violence in violent offenders' population: A meta-analytic review. *European Journal of Psychology Applied to Legal Context*, 4(1), 59–77.
- Chiesa A, Serretti A, Jakobsen JC (2013) Mindfulness: Top–down or bottom–up emotion regulation strategy? *Clinical Psychology Review* Volume 33, Issue 1, February 2013, pp 82-96 DOI: 10.1016/j.cpr.2012.10.006
- Colby M (2008). Verbal and working memory deficits in an impulsive aggressive college sample (Doctoral dissertation). Baylor University.
- Cole PM, Michel MK, Teti LO (1994). "The Development of Emotion Regulation and Dysregulation: A Clinical Perspective". *Monographs of the Society for Research in Child Development.* 59 (2/3): 73–100. doi:10.1111/j.1540-5834.1994.tb01278.x. JSTOR 1166139.
- Cole PM, Ramsook KA & Ram N (2019). Emotion dysregulation as a dynamic process. *Development and psychopathology*, 31(3), 1191-1201. DOI:10.1017/S0954579419000695

- Conners C, Erhardt D, Epstein J, Parker J, Sitarenios G & Sparrow EJJ o AD (1999). Self-ratings of ADHD symptoms in adults I: Factor structure and normative data. *Journal of Attention Disorders*, 3(3), 141-151. DOI: 10.1007/978-0-387-79948-3_1278
- Connor DF, Steeber J, McBurnett K. (2010) A review of attention-deficit/hyperactivity disorder complicated by symptoms of oppositional defiant disorder or conduct disorder. *Journal of Developmental & Behavioral Pediatrics*. 2010 Jun 1;31(5):427-40. <https://doi.org/10.1097/DBP.0b013e3181e121bd>
- Corbisiero S, Stieglitz RD, Retz W & Rosler M (2013). Is emotional dysregulation part of the psychopathology of ADHD in adults? *Atten Defic Hyperact Disord*, 5(2), 83-92. DOI:10.1007/s12402-012-0097-z
- Corbisiero S, Mörstedt B, Bitto H, Stieglitz RD. (2017) Emotional Dysregulation in Adults with Attention-Deficit/Hyperactivity Disorder-Validity, Predictability, Severity, and Comorbidity. *J Clin Psychol*. 2017 Jan;73(1):99-112. DOI: 10.1002/jclp.22317
- Cortese S, Faraone SV, Bernardi S, Wang S, Blanco C. (2016) Gender differences in adult attention-deficit/hyperactivity disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). *J Clin Psychiatry*. 2016 Apr;77(4):e421-8. DOI: 10.4088/JCP.14m09630
- Crunelle CL, Van Den Brink W, Moggi F, Konstenius M, Franck J, Levin FR, Van De Glind G, Demetrovics Z, Coetzee C, Luderer M, Schellekens A. (2018) International consensus statement on screening, diagnosis and treatment of substance use disorder patients with comorbid attention deficit/hyperactivity disorder. *European addiction research*. 2018;24(1):43-51. DOI: 10.1159/000487767
- Cumyn L, French L, Hechtman L. (2009) Comorbidity in adults with attention-deficit hyperactivity disorder. *Can J Psychiatry*. 2009 Oct;54(10):673-83. <https://doi.org/10.1371/journal.pone.0211873>
- Dalsgaard S, Mortensen PB, Frydenberg M, Thomsen PH, (2013) Long-term criminal outcome of children with attention deficit hyperactivity disorder. *Criminal behavior and mental health*, 10 April 2013 DOI: 10.1002/cbm.1860
- Dalsgaard S, Mortensen PB, Frydenberg M, & Thomsen PH (2014). ADHD, stimulant treatment in childhood and subsequent substance abuse in adulthood—a naturalistic long-term follow-up study. *Addictive Behaviors*, 39(1), 325-328. PMID: 24090624 DOI: 10.1016/j.addbeh.2013.09.002
- Davidson J, Turnbull CD, Strickland R, Miller R & Graves K (1986). The Montgomery-Asberg Depression Scale: Reliability and validity. *Acta Psychiatrica Scandinavica*, 73, 544–548. <https://doi.org/10.1111/j.1600-0447.1986.tb02723.x>
- Demontis D, Walters RK, Martin J, Mattheisen M, Als TD, Agerbo E, ... & Cerrato F. (2019). Discovery of the first genome-wide significant risk loci for attention deficit/hyperactivity disorder. *Nature genetics*, 51(1), 63. DOI: 10.1038/s41588-018-0269-7
- Derogatis LR, Rickels K & Rock AF (1976). The SCL-90 and the MMPI: a step in the validation of a new self-report scale. *The British Journal of Psychiatry*, 128(3), 280-289. DOI: 10.1192/bjp.128.3.280

- Diamond A (2005). Attention-deficit disorder (attention-deficit/ hyperactivity disorder without hyperactivity): A neurobiologically and behaviorally distinct disorder from attention-deficit/ hyperactivity disorder (with hyperactivity). *Development and Psychopathology*, 17, 807–825. <https://doi.org/10.1017/S0954579405050388>
- Diamond A (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>
- Dixon ML, Thiruchselvam R, Todd R & Christoff K (2017). Emotion and the prefrontal cortex: An integrative review. *Psychological bulletin*, 143(10), 1033. DOI: 10.1037/bul0000096
- Donfrancesco R, Di Trani M, Porfirio MC, Giana G, Miano S, & Andriola E (2015). Might the temperament be a bias in clinical study on attention-deficit hyperactivity disorder (ADHD)?: Novelty Seeking dimension as a core feature of ADHD. *Psychiatry research*, 227(2-3), 333-338. DOI: 10.1016/j.psychres.2015.02.014
- Dragland Å, (2021) Medisinering med bismak. Om forbruket av medisiner i psykiatri, eldreomsorg og adhd-behandling. Flux
- Dryman MT & Heimberg RG (2018). Emotion regulation in social anxiety and depression: a systematic review of expressive suppression and cognitive reappraisal. *Clin Psychol Rev*, 65, 17-42. DOI:10.1016/j.cpr.2018.07.004
- Du Rietz E, Kuja-Halkola R, Brikell I, Jangmo A, Sariaslan A, Lichtenstein P, Kuntsi J, Larsson H. (2017) Predictive validity of parent-and self-rated ADHD symptoms in adolescence on adverse socioeconomic and health outcomes. *European child & adolescent psychiatry*. 2017 Jul 1;26(7):857-67. DOI: 10.1007/s00787-017-0957-3
- Dvir Y, Ford JD, Hill M & Frazier JA (2014). Childhood maltreatment, emotional dysregulation, and psychiatric comorbidities. *Harvard review of psychiatry*, 22(3), 149. DOI: 10.1097/HRP.0000000000000014
- Ebejer JL, Medland SE, van der Werf J, Gondro C, Henders AK, Lynskey M, Martin NG, Duffy DL. (2012) Attention Deficit Hyperactivity Disorder in Australian Adults: Prevalence, Persistence, Conduct Problems and Disadvantage. Published: *Plos one*, Oct 10, 2012, Vol.7, Issue 10, e47404 DOI: 10.1371/journal.pone.0047404
- Egeland J (2015). Measuring working memory with digit span and the letter-number sequencing subtests from the WAIS-IV: Too low manipulation load and risk for underestimating modality effects. *Applied Neuropsychology: Adult*, 22, 445–451. <https://doi.org/10.1080/23279095.2014.992069>
- Ehsan AM & De Silva MJ. (2015) Social capital and common mental disorder: a systematic review. *J Epidemiol Community Health* 2015; 69:1021-1028. DOI: 10.1136/jech-2015-205868
- Einarsson E, Sigurdsson JF, Gudjonsson GH, Newton AK, Bragason OO. (2009) Screening for attention-deficit hyperactivity disorder and co-morbid mental disorders among prison inmates. *Nord J Psychiatry*. 2009;63(5):361-7. DOI:10.1080/08039480902759184
- Erskine HE, Norman RE, Ferrari AJ, Chan GC, Copeland WE, Whiteford HA, & Scott JG (2016). Long-term outcomes of attention-deficit/hyperactivity disorder and conduct

- disorder: a systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, 2016;55(10), 841-850. DOI: 10.1016/j.jaac.2016.06.016
- Evers A, Muniz J, Bartram D, Boben D, Egeland J, FernandezHermida JR, ... Urbanek T (2012). Testing practices in the 21st century: Developments and European psychologists' opinions. *European Psychologist*, 17, 300-319. <https://doi.org/10.1027/1016-9040/a000102>
- Evren C, Karabulut V, Alniak I, Evren B, Carkci OH, Yilmaz Cengel H, Ozkara Menekseoglu P, Cetin T, Bozkurt M, Umut G. (2019) Emotion dysregulation and internalizing symptoms affect relationships between ADHD symptoms and borderline personality features among male patients with substance use disorders. *Psychiatry and Clinical Psychopharmacology*. 2019 Mar 20:1-1. DOI: 10.1080/24750573.2019.1595271
- Fabio RA & Capri T (2017). The executive functions in a sample of Italian adults with ADHD: Attention, response inhibition and planning /organization. *Mediterranean Journal of Clinical Psychology*, 5(3). <https://doi.org/10.6092/2282-1619/2017.5.1636>
- Faraone SV & Biederman J (2005). What is the prevalence of adult ADHD? Results of a population screen of 966 adults. *Journal of Attention Disorders*, 9, 384-391. <https://doi.org/10.1177/1087054705281478>
- Faraone SV, Rostain AL, Blader J, Busch B, Childress AC, Connor DF, Newcorn JH. (2019) Practitioner Review: Emotional dysregulation in attention-deficit/hyperactivity disorder—implications for clinical recognition and intervention. *Journal of Child Psychology and Psychiatry*. 2019 Feb;60(2):133-50. doi: 10.1111/jcpp.12899.
- Faraone SV, Larsson H. (2019) Genetics of attention deficit hyperactivity disorder. *Molecular psychiatry*. 2019 Apr;24(4):562. DOI: 10.1038/s41380-018-0070-0
- Farooq R, Emerson LM, Keogh S, Adamou M. (2016) Prevalence of adult ADHD in an all-female prison unit. *ADHD Attention Deficit and Hyperactivity Disorders*. 2016 Jun 1;8(2):113-9. DOI: 10.1007/s12402-015-0186-x
- Fatséas M, Hurmic H, Serre F, Debrabant R, Daulouède JP, Denis C, Auriacombe M. (2016) Addiction severity pattern associated with adult and childhood attention deficit hyperactivity disorder (ADHD) in patients with addictions. *Psychiatry Res* 2016; 246: 656-662. DOI: 10.1016/j.psychres.2016.10.071
- Fayyad J, De Graaf R, Kessler R, Alonso J, Angermeyer M, Demyttenaere K, De Girolamo G, Haro JM, Karam EG, Lara C, Lépine JP, Ormel J, Posada-Villa J, Zaslavsky AM, Jin R. (2007). Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *Br J Psychiatry*. 2007 May;190:402-9. DOI: 10.1192/bjp.bp.106.034389
- Fazel S, Bains P, Doll H. (2006) Substance abuse and dependence in prisoners: a systematic review. *Addiction*. First published: 24 January 2006 DOI: 10.1111/j.1360-0443.2006.01316.x
- Fisher AC, Rushby JA, McDonald S, Parks N & Pigué O (2015). Neurophysiological correlates of dysregulated emotional arousal in severe traumatic brain injury. *Clinical Neurophysiology*, 126(2), 314-324. DOI: 10.1016/j.clinph.2014.05.033

- Fletcher J & Wolfe B. (2009) Long-term Consequences of Childhood ADHD on Criminal Activities. *J Ment Health Policy Econ.* 2009 Sep; 12(3): 119–138. PMID: 19996475
- Ford JD & Courtois CA (2021). Complex PTSD and borderline personality disorder. *Borderline personality disorder and emotion dysregulation*, 8(1), 1-21. DOI:10.1186/2051-6673-1-9
- Frazier TW, Demaree HA & Youngstrom EA (2004). Meta-analysis of intellectual and neuropsychological test performance in attention-deficit/hyperactivity disorder. *Neuropsychology*, 18, 543–555. <https://doi.org/10.1037/0894-4105.18.3.543>
- Fredriksen M, Dahl AA, Martinsen EW, Klungsøyr O, Haavik J, Peleikis DE. (2014) Effectiveness of one-year pharmacological treatment of adult attention-deficit/hyperactivity disorder (ADHD): an open-label prospective study of time in treatment, dose, side-effects and comorbidity. *Eur Neuropsychopharmacol.* 2014 Dec;24(12):1873-84. <https://doi.org/10.1016/j.euroneuro.2014.09.013>
- Fried R, Petty C, Faraone SV, Hyder LL, Day H & Biederman J (2016). Is ADHD a risk factor for high school dropout? A controlled study. *Journal of attention disorders*, 20(5), 383-389. DOI:10.1177/1087054712473180
- Fuermaier AB, Fricke JA, de Vries SM, Tucha L & Tucha O (2018). Neuropsychological assessment of adults with ADHD: A Delphi consensus study. *Applied Neuropsychology: Adult.* Jul-Aug 2019;26(4):340-354. DOI:10.1080/23279095.2018.1429441.
- Fuermaier A, Tucha L, Butzbach M, Weisbrod M, Aschenbrenner S & Tucha O (2021). ADHD at the workplace: ADHD symptoms, diagnostic status, and work-related functioning. *Journal of neural transmission (Vienna, Austria)*, 128(7), 1021–1031. <https://doi.org/10.1007/s00702-021-02309-z>
- Garcia CR, Bau CHD, Silva KL, Callegari-Jacques SM, Salgado CAI; Fischer AG; Victor MM; Sousa NO; Karam RG; Rohde LA; Belmonte-De-Abreu P; Grevet EH (2010) The burdened life of adults with ADHD: Impairment beyond comorbidity. *European psychiatry: the journal of the Association of European Psychiatrists*, July 2012, Vol.27(5), pp.309-13 doi:10.1016/j.eurpsy.2010.08.002
- Garofalo C & Velotti P (2017). Negative emotionality and aggression in violent offenders: The moderating role of emotion dysregulation. *Journal of Criminal Justice*, 51, 9-16. DOI: 10.1016/j.jcrimjus.2017.05.015.
- 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.* 2010 Dec 22;10:112. DOI: 10.1186/1471-244X-10-112
- Gisbert L, Richarte V, Corrales M, Ibanez P, Bosch R, Casas M, & Ramos-Quiroga JA (2018). The Impact of Emotional Lability Symptoms During Childhood in Adults With ADHD. *J Atten Disord*, 22(6), 581-590. DOI:10.1177/1087054717719534
- Gisbert L, Richarte V, Corrales M, Ibanez P, Bosch R, Bellina M, Ramos-Quiroga JA (2019). The relationship between neuropsychological deficits and emotional lability in adults with ADHD. *Journal of Attention Disorders*, 23, 1514–1525. <https://doi.org/10.1177/1087054718780323>

- Gisbert L, Vilar L, Rovira P, Sánchez-Mora C, Pagerols M, Garcia-Martínez I, Richarte V, Corrales M, Casas M, Ramos-Quiroga JA, Artigas MS. (2019) Genome-wide analysis of emotional lability in adult attention deficit hyperactivity disorder (ADHD). *European Neuropsychopharmacology*. 2019 May 10. DOI: 10.1016/j.euroneuro.2019.04.004]
- Gjervan B, Torgersen T, Nordahl HM and Rasmussen K. (2012) Functional Impairment and Occupational Outcome in Adults With ADHD. *Journal of Attention Disorders*, 2012; 16(7) 544-552 DOI:10.1177/1087054711413074
- Goodman M, Carpenter D, Tang CY, Goldstein KE, Avedon J, Fernandez N, Mascitelli KA, Blair NJ, New AS, Triebwasser J, Siever LJ, Hazlett EA. (2014) Dialectical behavior therapy alters emotion regulation and amygdala activity in patients with borderline personality disorder. *J Psychiatr Res*. 2014 Oct;57:108-16. DOI: 10.1016/j.jpsychires.2014.06.020.
- Gonçalves DA et al: (2014) Brazilian multicentre study of common mental disorders in primary care: rates and related social and demographic factors. *Cadernos de Saúde Pública*, Rio de Janeiro, Mar 2014, 30(3):623-632 DOI: 10.1590/0102-311x00158412
- González RA, Gudjonsson GH, Wells J & Young S. (2016). The role of emotional distress and ADHD on institutional behavioral disturbance and recidivism among offenders. *Journal of Attention Disorders*, 20, 368-78 DOI: 10.1177/1087054713493322
- Gorlyn M, Keilp JG, Oquendo MA, Burke AK, Sackeim HA & Mann J (2006). The WAIS-III and major depression: Absence of VIQ/PIQ differences. *Journal of Clinical and Experimental Neuropsychology*, 28, 1145–1157. DOI: 10.1080/13803390500246944
- Grant BF, Goldstein RB, Saha TD, Chou SP, Jung J, Zhang H, Pickering RP, Ruan WJ, Smith SM, Huang B, Hasin DS. (2015) Epidemiology of DSM-5 alcohol use disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA psychiatry*. 2015 Aug 1;72(8):757-66. DOI: 10.1001/jamapsychiatry.2015.0584
- Grant BF, Saha TD, Ruan WJ, Goldstein RB, Chou SP, Jung J, Zhang H, Smith SM, Pickering RP, Huang B, Hasin DS. (2016) Epidemiology of DSM-5 drug use disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions—III. *JAMA psychiatry*. 2016 Jan 1;73(1):39-47. DOI: 10.1001/jamapsychiatry.2015.2132
- Gratz KL & Roemer L (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the Difficulties in Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment*, 26, 41-54. <https://doi.org/10.1023/B:JOBA.0000007455.08539.94>
- Gratz KL, Weiss NH & Tull MT (2015). Examining Emotion Regulation as an Outcome, Mechanism, or Target of Psychological Treatments. *Curr Opin Psychol*, 3, 85-90. doi:10.1016/j.copsyc.2015.02.010
- Green MJ, Cahill CM & Malhi GS (2007). The cognitive and neurophysiological basis of emotion dysregulation in bipolar disorder. *Journal of affective disorders*, 103(1-3), 29-42. DOI: 10.1016/j.jad.2007.01.024
- Green M, & Benzeval M. (2013) The development of socioeconomic inequalities in anxiety and depression symptoms over the lifecourse. *Social Psychiatry and Psychiatric Epidemiology*, 2013, Vol.48(12), pp.1951-1961 DOI: 10.1007/s00127-013-0720-0

- Gross JJ (1998). The emerging field of emotion regulation: An integrative review. *Review of general psychology*, 2(3), 271-299. <http://dx.doi.org/10.1037/1089-2680.2.3.271>
- Gudjonsson GH, Sigurdsson JF, Adalsteinsson TF & Young S (2013). The relationship between ADHD symptoms, mood instability, and self-reported offending. *Journal of attention disorders*, 17(4), 339-346. DOI: 10.1177/1087054712437584
- Gudjonsson GH, Sigurdsson JF, Sigfusdottir ID & Young S (2014). A national epidemiological study of offending and its relationship with ADHD symptoms and associated risk factors. *Journal of attention disorders*, 2014, 18(1), 3-13. DOI: 10.1111/j.1469-7610.2011.02489.x
- Gudjonsson GH, Sigurdsson JF, Sigfusdottir ID, Asgeirsdottir BB, González RA & Young S (2016). A national epidemiological study investigating risk factors for police interrogation and false confession among juveniles and young persons. *Social psychiatry and psychiatric epidemiology*, 51(3), 359-367. DOI:10.1007/s00127-015-1145-8
- Gudjonsson GH, Gonzalez R & Young S (2019). The risk of making a false confession: The role of developmental disorders, conduct disorder, psychiatric symptoms, and compliance. *Journal of Attention Disorders*. 21 Mar 2019, 25(5):715-723 DOI: 10.1177/1087054719833169
- Haavik J, Halmoy A, Lundervold AJ & Fasmer OB (2010). Clinical assessment and diagnosis of adults with attention-deficit/hyperactivity disorder. *Expert Rev Neurother*, 10(10), 1569-1580. DOI: 10.1586/ern.10.149
- Halleland HB, Haavik J & Lundervold AJ (2012). Set-shifting in adults with ADHD. *Journal of the International Neuropsychological Society*, 18, 728-737. <https://doi.org/10.1017/S1355617712000355>
- Halmøy A, Fasmer OB, Gillberg C, Haavik J (2009) Occupational Outcome in Adult ADHD: Impact of Symptom Profile, Comorbid Psychiatric Problems, and Treatment--A Cross-Sectional Study of 414 Clinically Diagnosed Adult ADHD Patients. *Journal of Attention Disorders*, 2009, Vol.13(2), p.175-187 DOI: 10.1177/1087054708329777
- Hammen C. (2005) Stress and Depression. *Annual Review of Clinical Psychology*; 1:293-319. <https://doi.org/10.1146/annurev.clinpsy.1.102803.143938>
- Harrison AG, DeLisle MM & Parker KCH (2008). An investigation of the General Abilities Index in a group of diagnostically mixed patients. *Journal of Psychoeducational Assessment*, 26, 247-259. <https://doi.org/10.1177/0734282907304032>
- Healey LV, Holmes V, Curry S, Seto MC, & Ahmed AG (2019). Self-reported dysfunctional anger in men and women at a psychiatric outpatient clinic. *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, 37(4), 395-410. DOI:10.1007/S10942-019-00318-2
- Heatherton TF & Wagner DD (2011). Cognitive neuroscience of self-regulation failure. *Trends in cognitive sciences*, 15(3), 132-139. DOI: 10.1016/j.tics.2010.12.005
- Helsetilsynet (2005) helsetilsynet.no/historisk-arkiv/brev-og-horingsuttalelser/brev-hoeringsuttalelser-2005/Rundskriv-rekvirering-legemidler-ADHD-narkolepsi-hoeringsuttalelse/

- Henry C, Phillips M, Leibenluft E, M'Bailara K, Houenou J & Leboyer M (2012). Emotional dysfunction as a marker of bipolar disorders. *Front Biosci (Elite Ed)*, 4, 2622-2630. DOI: 10.2741/e578
- Hervas A (2017). Emotional dysregulation and autism spectrum disorders. *Revista de neurologia*, 64(s01), S17-S25. PMID: 28256682
- Hirsch O, Chavanon M, Reichmann E & Christiansen H (2018). Emotional dysregulation is a primary symptom in adult Attention-Deficit/Hyperactivity Disorder (ADHD). *Journal of Affective Disorders*, 232,41–47. <https://doi.org/10.1016/j.jad.2018.02.007>
- Hirvikoski T, Waaler E, Alfredsson J, Pihlgren C, Holmström A, Johnson A, Rück J, Wiwe C, Bothén P, Nordström AL. (2011) Reduced ADHD symptoms in adults with ADHD after structured skills training group: results from a randomized controlled trial. *Behav Res Ther*. 2011 Mar;49(3):175-85. doi: 10.1016/j.brat.2011.01.001.
- Hofmann SG, Sawyer AT, Fang A & Asnaani A (2012). Emotion dysregulation model of mood and anxiety disorders. *Depress Anxiety*, 29(5), 409-416. doi:10.1002/da.21888
- Holwerda A, van der Klink JJJ, de Boer MR, Groothoff JW, Brouwer S. (2013) Predictors of sustainable work participation of young adults with developmental disorders. *Research in Developmental Disabilities* 34 (2013) 2753–2763 DOI: 10.1016/j.ridd.2013.05.032
- Horning S & Davis HP (2012). Aging and cognition in Encyclopedia of human behavior (2nd ed., pp. 44–52). London: Academic Press. <https://doi.org/10.1016/B978-0-12-375000-6.00007-0>
- Hyde JS (2014). Gender similarities and differences. *Annual review of psychology*, 65, 373-398. <https://doi.org/10.1146/annurev-psych-010213-115057>
- IBM (2013). SPSS statistics for Windows, Version 22.0. Armonk, NY: Author. Released 2013. IBM Corp DOI: 10.4135/9781526435439
- Inaba A, Thoitsb P, Uenoc K, Goved W, Evensond R, Sloand M. (2005) Depression in the United States and Japan: Gender, marital status, and SES patterns. *Social Science & Medicine* 61 (2005) 2280–2292 DOI: 10.1016/j.socscimed.2005.07.014
- Ismail Z, Gatchel J, Bateman DR, Barcelos-Ferreira R, Cantillon M, Jaeger J, .. & Mortby ME (2018). Affective and emotional dysregulation as pre-dementia risk markers: exploring the mild behavioral impairment symptoms of depression, anxiety, irritability, and euphoria. *International psychogeriatrics*, 30(2), 185-196. DOI: 10.1017/S1041610217001880
- Iverson GL, Lange RT, Viljoen H & Brink J (2006). WAIS-III General Ability Index in neuropsychiatry and forensic psychiatry inpatient samples. *Archives of Clinical Neuropsychology*, 21,77–82. <https://doi.org/10.1016/j.acn.2005.07.007>
- Jaber L, Kirsh D, Diamond G, Shuper A (2015) Long-Term Functional Outcomes in Israeli Adults Diagnosed in Childhood with Attention Deficit Hyperactivity Disorder. *The Israel Medical Association journal*: August 2015, Vol.17(8):481-5 PMID: 26394489
- Jacob CP, Romanos J, Dempfle A, Heine M, Windemuth-Kieselbach C, Kruse A, ... & Lesch, KP (2007). Co-morbidity of adult attention-deficit/hyperactivity disorder with focus on personality traits and related disorders in a tertiary referral center. *European archives of psychiatry and clinical neuroscience*, 257(6), 309-317 DOI:10.1007/s00406-007-0722-6

- Jacobi F, Wittchen H-U, Höltling C, Höfler M, Pfister H, Müller N, Lieb R. (2004) Prevalence, comorbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychol Med* 2004; 34:597–611 DOI: 10.1017/S0033291703001399
- Jacobson LA, Geist M & Mahone EM (2018). Sluggish cognitive tempo, processing speed, and internalizing symptoms: The moderating effect of age. *Journal of Abnormal Child Psychology*, 46(1), 127–135. <https://doi.org/10.1007/s10802-017-0281-x>
- Jasielska A, Kaczmarek L, Bronska A, Dominiak M, Niemier K, Patalas D, ... Tomczak M (2015). The relationship between working memory and emotion regulation strategies. *Roczniki Psychologiczne*, 18, 567–578. <https://doi.org/10.18290/rpsych.2015.18.4-4en>
- Jensen DA, Høvik MF, Monsen NJN, Eggen TH, Eichele H, Adolfsdottir S, ... Sørensen L (2018). Keeping emotions in mind: The influence of working memory capacity on parent-reported symptoms of emotional lability in a sample of children with and without ADHD. *Frontiers in Psychology*, 9, 1846. DOI: 10.3389/fpsyg.2018.01846
- Kasper LJ, Alderson RM & Hudec KL (2012). MODERATORS of working memory deficits in children with attention-deficit/hyperactivity disorder (ADHD): A meta-analytic review. *Clinical Psychology Review*, 32, 605–617. DOI: 10.1016/j.cpr.2012.07.001
- Kaufman A (1999) The essentials of WAIS-III assessment. *Essentials of psychological assessment series* c1999
- Kendler KS, Aggen SH, Tambs K, Reichborn-Kjennerud T. (2006) Illicit psychoactive substance use, abuse and dependence in a population-based sample of Norwegian twins. *Psychological Medicine*, 02 May 2006, 36(7):955-962 DOI:10.1017/S0033291706007720
- Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, Wittchen H-U, Kendler KS: (1994) Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey. *Arch Gen Psychiatry* 1994; 51:8-19 DOI: 10.1001/archpsyc.1994.03950010008002
- Kessler RC, Adler L, Ames M, Demler O, Faraone S, Hiripi EV, Howes MJ, Jin R, Secnik K, Spencer T, Üstün TB. (2005) The World Health Organization Adult ADHD Self-Report Scale (ASRS): a short screening scale for use in the general population. *Psychological medicine*. 2005; Feb;35(2):245-56. DOI:10.1017/ s003329170400289222
- Kessler RC, Adler L, Ames M, Barkley RA, Birnbaum H, Greenberg P, ... & Üstün TB (2005). The Prevalence and Effects of Adult Attention Deficit/Hyperactivity Disorder on Work Performance in a Nationally Representative Sample of Workers. *Journal of Occupational and Environmental Medicine*. Volume 47, Number 6, June 565-572. 2005 DOI: 10.1097/01.jom.0000166863.33541.39
- Kessler RC, Chiu WT, Demler O, Walters EE. (2005) Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005; 62:617–627 doi: 10.1001/archpsyc.62.6.617
- Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, Faraone SV, Greenhill LL, Howes MJ, Secnik K, Spencer T, Ustun TB, Walters EE, Zaslavsky AM. (2006) The prevalence and correlates of adult ADHD in the United States: results from the

- National Comorbidity Survey Replication. *The American Journal of Psychiatry*, Apr 2006, Vol.163(4), pp.716-23 DOI: 10.1176/ajp.2006.163.4.716
- Kibby MY, Vadnais SA & Jagger-Rickels AC (2019). Which components of processing speed are affected in ADHD subtypes? *Child Neuropsychology*, 25, 964–979. <https://doi.org/10.1080/09297049.2018.1556625>
- Knecht C, de Alvaro R, Martinez-Raga J and Balanza-Martinez V. (2015) Attention-deficit hyperactivity disorder (ADHD), substance use disorders, and criminality: a difficult problem with complex solutions. *Int J Adolesc Med Health* 2015; 27(2): 163–175 DOI: 10.1515/ijamh-2015-5007
- Kockler TR & Stanford MS (2008). Using a clinically aggressive sample to examine the association between impulsivity, executive functioning, and verbal learning and memory. *Archives of Clinical Neuropsychology*, 23(2), 165–173. DOI: 10.1016/j.acn.2007.10.006
- Kooij SJJ, Bejerot S, ... Asherson P (2010) European consensus statement on diagnosis and treatment of adult ADHD: The European Network Adult ADHD. *BMC Psychiatry* 2010, 10:67 <http://www.biomedcentral.com/1471-244X/10/67>
- Kooij SJJ & Francken MH (2010). Diagnostic interview for ADHD in adults 2.0 (DIVA 2.0). *Adult ADHD: Diagnostic assessment and treatment*, 33-99. DOI: 10.1007/978-1-4471-4138-9_3
- Kringlen E, Torgersen S, Cramer V. (2001) A Norwegian psychiatric epidemiological study. *American journal of psychiatry*. 2001 Jul 1;158(7):1091-8. DOI:10.1176/appi.ajp.158.7.1091
- Krueger RF, Schmutte PS, Caspi A, Moffitt TE, Campbell K, & Silva PA (1994). Personality traits are linked to crime among men and women: evidence from a birth cohort. *Journal of abnormal psychology*, 103(2), 328. DOI: 10.1037/0021-843X.103.2.328
- Kubo Y, Kanazawa T, Kawabata Y, Tanaka K, Okayama T, Fujita M, ... Yoneda H (2018). Comparative analysis of the WISC between two ADHD subgroups. *Psychiatry Investigation*, 15 (2), 172. <https://doi.org/10.30773/pi.2017.07.12>
- Küpper T, Haavik J, Drexler H, Ramos-Quiroga JA, Wermelskirchen D, Prutz C, Schauble B. (2012) The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. *International Archives of Occupational and Environmental Health*, November 2012, Volume 85, Issue 8, pp 837–847 DOI: 10.1007/s00420-012-0794-0
- Landaas ET, Halmøy A, Oedegaard KJ, Fasmer OB & Haavik J (2012). The impact of cyclothymic temperament in adult ADHD. *Journal of Affective Disorders*, 142(1–3), 241–247. <https://doi.org/10.1016/j.jad.2012.04.034>
- Lange KW, Reichl S, Lange KM, Tucha L, Tucha O. (2010) The history of attention deficit hyperactivity disorder. *Atten Defic Hyperact Disord*. 2010 Dec;2(4):241-55. doi: 10.1007/s12402-010-0045-8.
- Leer, K (2021) ADHD - 7 veier til ny forståelse, p 224, Cappelen Damm

- Leiknes KA, Leganger S, Malt EA, et al. MINI International Neuropsychiatric Interview (1992–2009). MINI Internasjonalt neuropsykiatrisk intervju, Norwegian version 5.0.0 and 6.0.0. Norway/Norwegian-Mapi Research Institute.
- Lenzi F, Cortese S, Harris J & Masi G (2018). Pharmacotherapy of emotional dysregulation in adults with ADHD: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, *84*, 359-367. DOI:10.1016/j.neubiorev.2017.08.010
- Lichtenstein P, Halldner L, Zetterqvist J, Sjölander A, Serlachius E, Fazel S, ... & Larsson H (2012). Medication for attention deficit–hyperactivity disorder and criminality. *New England Journal of Medicine*, *367*(21), 2006-2014. DOI: 10.1056/NEJMoa1203241
- Lima IM, Peckham AD & Johnson SL (2018). Cognitive deficits in bipolar disorders: Implications for emotion. *Clinical Psychology Review*, *59*, 126–136. <https://doi.org/10.1016/j.cpr.2017.11.006>
- Lochman JE, Barry T, Powell N & Young L (2010). Anger and aggression. In Practitioner's guide to empirically based measures of social skills (pp. 155–166). New York, NY: Springer. https://doi.org/10.1007/978-1-4419-0609-0_10
- Lopez-Pinar C, Martinez-Sanchis S, Carbonell-Vaya E, Fenollar-Cortes J & Sanchez-Meca J (2018). Long-Term Efficacy of Psychosocial Treatments for Adults With Attention-Deficit/Hyperactivity Disorder: A Meta-Analytic Review. *Front Psychol*, *9*, 638. doi:10.3389/fpsyg.2018.00638
- Mann FD, Engelhardt L, Briley DA, Grotzinger AD, Patterson MW, Tackett JL, ... & Martin NG (2017). Sensation seeking and impulsive traits as personality endophenotypes for antisocial behavior: Evidence from two independent samples. *Personality and individual differences*, *105*, 30-39. <https://doi.org/10.1016/j.paid.2016.09.018>
- Mannuzza S, Klein RG, Bessler A, Malloy P, LaPadula M: (1993) Adult Outcome of Hyperactive Boys Educational Achievement, Occupational Rank, and Psychiatric Status; *Arch Gen Psychiatry*. 1993;50:565-576 DOI: 10.1001/archpsyc.1993.01820190067007
- Martel MM (2009). Research review: a new perspective on attention-deficit/hyperactivity disorder: emotion dysregulation and trait models. *J Child Psychol Psychiatry*, *50*(9), 1042-1051. <https://doi.org/10.1111/j.1469-7610.2009.02105.x>
- Martinussen R, Hayden J, Hogg-Johnson S & Tannock R (2005). A meta-analysis of working memory impairments in children with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *44*, 377–384. <https://doi.org/10.1097/01.chi.0000153228.72591.73>
- Mayes SD & Calhoun SL (2007). Learning, attention, writing, and processing speed in typical children and children with ADHD, autism, anxiety, depression, and oppositional-defiant disorder. *Child Neuropsychology*, *13*, 469–493. doi: 10.1080/09297040601112773
- McQuade JD, Murray-Close D, Shoulberg EK & Hoza B (2013). Working memory and social functioning in children. *Journal of Experimental Child Psychology*, *115*, 422–435. <https://doi.org/10.1016/j.jecp.2013.03.002>

- McRae K, Misra S, Prasad AK, Pereira SC & Gross JJ (2012). Bottom-up and top-down emotion generation: implications for emotion regulation. *Social cognitive and affective neuroscience*, 7(3), 253-262. DOI: 10.1093/scan/nsq103
- Montgomery SA & Asberg M (1979). A new depression scale designed to be sensitive to change. *British Journal of Psychiatry*, 134, 382–389 doi: 10.1192/bjp.134.4.382
- 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 Psychology Review* 48, 2016, 32–42 DOI: 10.1016/j.cpr.2016.05.002
- Monteiro MS, Ilmarinen J, Corraa Filho HR (2006) Work ability of workers in different age groups in a public health institution in Brazil. *Int J Occup Saf Ergon* 2006;12(4):417-27. 18 DOI: 10.1080/10803548.2006.11076703
- Moore DS, Notz WI & Notz W (2006). *Statistics: Concepts and controversies*. New York, NY: Macmillan.
- Mordal J, Gundersen O, Bramness JG (2010) Norwegian version of the mini-international neuropsychiatric interview: feasibility, acceptability and test-retest reliability in an acute psychiatric ward. *Eur Psychiatry* 2010;25:172–7. DOI: 10.1016/j.eurpsy.2009.02.004
- Murphy K and Barkley R. (1996) Attention deficit hyperactivity disorder adults: Comorbidities and adaptive impairments. *Comprehensive Psychiatry*, 1996, Vol.37(6), pp.393-401 DOI: 10.1016/s0010-440x(96)90022-x
- Musser ED, Galloway-Long HS, Frick PJ, Nigg JT. (2013) Emotion regulation and heterogeneity in attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*. 2013 Feb;52(2):163-171.e2. DOI: 10.1016/j.jaac.2012.11.009
- Ng JWL, Kwan R, Cheng Soon Cheok C. (2017) Clinical and Functional Outcomes in Young Adult Males With ADHD. *Journal of Attention Disorders*, 2017, Vol.21(6):465-474 <https://doi.org/10.1177/1087054714548034>
- Nigg JT, Stavro G, Ettenhofer M, Hambrick DZ, Miller T & Henderson JM (2005). Executive functions and ADHD in adults: Evidence for selective effects on ADHD symptom domains. *Journal of Abnormal Psychology*, 114, 706–717. doi: 10.1037/0021-843X.114.3.706
- Nikolas MA, Marshall P & Hoelzle JB (2019). The role of neurocognitive tests in the assessment of adult attention-deficit/hyperactivity disorder. *Psychological Assessment*, 31, 685–698. <https://doi.org/10.1037/pas0000688>
- Nohr EA & Olsen J (2013) Commentary. Epidemiologists have debated representativeness for more than 40 years—has the time come to move on? *Int J Epidemiol* 2013; 42 (4): 1016-1017 DOI: 10.1093/ije/dyt102
- Nolen-Hoeksema S (2012). Emotion regulation and psychopathology: the role of gender. *Annu Rev Clin Psychol*, 8, 161-187. doi:10.1146/annurev-clinpsy-032511-143109
- Oddo LE, Knouse LE, Surman CBH, Safren SA. (2018) Investigating resilience to depression in adults with ADHD, *Journal of Attention Disorders*, 2018 Mar;22(5):497-505. doi: 10.1177/1087054716636937.

- O’Keeffe F, Liégeois F, Eve M, Ganesan V, King J, & Murphy T (2014). Neuropsychological and neurobehavioral outcome following childhood arterial ischemic stroke: attention deficits, emotional dysregulation, and executive dysfunction. *Child Neuropsychology*, 20(5), 557-582. DOI:10.1080/09297049.2013.832740
- Otto B, Misra S, Prasad A & McRae K (2014) Functional overlap of top-down emotion regulation and generation: An fMRI study identifying common neural substrates between cognitive reappraisal and cognitively generated emotions *Cogn Affect Behav Neurosci* DOI: 10.3758/s13415-013-0240-0
- Paananen R, Ristikari T, Merikukka M, Gissler M (2013) Social determinants of mental health: a Finnish nationwide follow-up study on mental disorders. *J Epidemiol Community Health* 2013;67:1025–1031. <https://www.jstor.org/stable/43281664>
- Pardini DA & Fite PJ (2010). Symptoms of conduct disorder, oppositional defiant disorder, attention-deficit/hyperactivity disorder, and callous-unemotional traits as unique predictors of psychosocial maladjustment in boys: Advancing an evidence base for DSM-V. *Journal of the American Academy of Child & Adolescent Psychiatry*, 49(11), 1134-1144. DOI: 10.1016/j.jaac.2010.07.010
- Persampiere J, Poole G & Murphy CM (2014). Neuropsychological correlates of anger, hostility, and relationship-relevant distortions in thinking among partner violent men. *Journal of Family Violence*, 29, 625–641. <https://doi.org/10.1007/s10896-014-9614-5>
- Philipsen A, Jans T, Graf E, Matthies S, Borel P, Colla M, Gentschow L, Langner D, Jacob C, Groß-Lesch S, Sobanski E, Alm B, Schumacher-Stien M, Roesler M, Retz W, Retz-Junginger P, Kis B, Abdel-Hamid M, Heinrich V, Huss M, Kornmann C, Bürger A, Perlov E, Ihorst G, Schlander M, Berger M, Tebartz van Elst L; (2015) Comparison of Methylphenidate and Psychotherapy in Adult ADHD Study (COMPAS) Consortium. Effects of Group Psychotherapy, Individual Counseling, Methylphenidate, and Placebo in the Treatment of Adult Attention-Deficit/Hyperactivity Disorder: A Randomized Clinical Trial. *JAMA Psychiatry*. 2015 Dec;72(12):1199-210. doi: 10.1001/jamapsychiatry.2015.2146.
- Piñeiro-Dieguez B, Balanzá-Martínez V, García-García P, Soler-López B. (2016) Psychiatric Comorbidity at the Time of Diagnosis in Adults With ADHD: The CAT Study. *Journal of Attention Disorders*. 2016, Vol.20(12):1066-1075 <https://doi.org/10.1177/1087054713518240>
- Pingault J-B, Côté SM, Lacourse E, Galéra C, Vitaro F, Tremblay RE. (2013) Childhood Hyperactivity, Physical Aggression and Criminality: A 19-Year Prospective Population-Based Study. Published: *PLOS ONE*, May 1, 2013 Volume 8 | Issue 5 | e62594) DOI: 10.1371/journal.pone.0062594
- Plant EA, Hyde JS, Keltner D & Devine PG (2000). The gender stereotyping of emotions. *Psychology of women quarterly*, 24(1), 81-92. <https://doi.org/10.1111/j.1471-6402.2000.tb01024.x>
- Pynoos RS, Steinberg AM, Piacentini JC (1999). "A developmental psychopathology model of childhood traumatic stress and intersection with anxiety disorders". *Biological Psychiatry*. 46 (11): 1542–54. DOI: 10.1016/s0006-3223(99)00262-0.

- Ramos AA, Hamdan AC & Machado L (2019). A meta-analysis on verbal working memory in children and adolescents with ADHD. *Clinical Neuropsychologist*, 2019,1–26. <https://doi.org/10.1080/13854046.2019.1604998>
- Ramos-Quiroga JA, Nasillo V, Richarte V, Corrales M, Palma F, Ibanez P & Kooij JS (2019). Criteria and concurrent validity of DIVA 2.0: A semi-structured diagnostic interview for adult ADHD. *Journal of Attention Disorders*, 23, 1126–1135. <https://doi.org/10.1177/1087054716646451>
- Rappaport MD, Chung KM, Shore G & Isaacs P (2001). A conceptual model of child psychopathology: Implications for understanding attention deficit hyperactivity disorder and treatment efficacy. *Journal of Clinical Child Psychology*, 30(1), 48–58. https://doi.org/10.1207/s15374424jccp3001_6
- Rappaport MD, Alderson RM, Kofler MJ, Sarver DE, Bolden J & Sims V (2008). Working memory deficits in boys with Attention-deficit/Hyperactivity Disorder 76 (ADHD): The contribution of central executive and subsystem processes. *Journal of Abnormal Child Psychology*, 36, 825–837. <https://doi.org/10.1007/s10802-008-9215-y>
- Rasmussen K & Levander S (2009) Untreated ADHD in Adults Are There Sex Differences in Symptoms, Comorbidity, and Impairment? *Journal of Attention Disorders*. 2009; 12(4):353-360 <https://doi.org/10.1177/1087054708314621>
- Rehm J, Room R, van den Brink W, & Jacobi F. (2005) Alcohol use disorders in EU countries and Norway: an overview of the epidemiology. *European Neuropsychopharmacology*, 2005, 15,4,377-388 DOI:10.1016/j.euroneuro.2005.04.005
- Reimherr FW, Marchant BK, Strong RE, Hedges DW, Adler L, Spencer TJ, ... & Soni P (2005). Emotional dysregulation in adult ADHD and response to atomoxetine. *Biological psychiatry*, 58(2), 125-131. <https://doi.org/10.1016/j.biopsych.2005.04.040>
- Reimherr FW, Roesler M, Marchant BK, Gift TE, Retz W, Philipp-Wiegmann F & Reimherr ML (2020). Types of adult attention-deficit/hyperactivity disorder: a replication analysis. *The Journal of clinical psychiatry*, 81(2), 0-0. DOI: 10.4088/JCP.19m13077
- Reitan RM & Wolfson D (1995). Influence of age and education on neuropsychological test results. *The Clinical Neuropsychologist*, 9(2), 151-158. DOI: 10.1080/13854049508401597
- Retz W, Stieglitz RD, Corbisiero S, Retz-Junginger P & Rosler M (2012). Emotional dysregulation in adult ADHD: What is the empirical evidence? *Expert Review of Neurotherapeutics*, 12, 1241–1251. <https://doi.org/10.1586/ern.12.109>
- Retz W, Ginsberg Y, Turner D, Barra S, Retz-Junginger P, Larsson H & Asherson P (2021). Attention-Deficit/Hyperactivity Disorder (ADHD), antisociality and delinquent behavior over the lifespan. *Neuroscience & Biobehavioral Reviews*. 236-248 DOI: 10.1016/j.neubiorev.2020.11.025
- Rhodes SM, Park J, Seth S & Coghill DR (2012). A comprehensive investigation of memory impairment in attention deficit hyperactivity disorder and oppositional defiant disorder. *Journal of Child Psychology and Psychiatry*, 53(2), 128–137. doi: 10.1111/j.14697610.2011.02436.x

- Robison RJ, Reimherr FW, Marchant BK, Faraone SV, Adler LA, & West SA. (2008) Gender differences in 2 clinical trials of adults with attention-deficit/hyperactivity disorder: a retrospective data analysis. *The Journal of clinical psychiatry*, 2008. 69(2), 213-221. DOI: 10.4088/JCP.v69n0207
- Rodgers B (1991) Models of stress, vulnerability and affective disorder. *J Affective Disorders*, 1991; 21:1-13. DOI: 10.1016/0165-0327(91)90012-h
- Ross CE and Mirowsky J (1995): Does Employment Affect Health? *Journal of Health and Social Behavior* 1995; 36:230-243. <https://doi.org/10.2307/2137340>
- Rothman K & Greenland S (1998) Modern Epidemiology. 2nd ed. Philadelphia: Lippincott-Raven, 1998. *Epidemiology*, Vol. 9, No. 3 (May, 1998), pp. 333-337
- Rothman KJ, Gallacher JEJ & Hatch EE: (2013) Why representativeness should be avoided. *International Journal of Epidemiology* 2013;42:1012–1014 <https://doi.org/10.1093/ije/dys223>
- Rucklidge JJ & Tannock R (2001). Psychiatric, psychosocial, and cognitive functioning of female adolescents with ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40, 530–540. doi: 10.1097/00004583-200105000-00012
- Rudolph KD (2002). Gender differences in emotional responses to interpersonal stress during adolescence. *J Adolesc Health*. 2002 Apr;30(4 Suppl):3-13. DOI: 10.1016/s1054-139x(01)00383-4
- Russell AE, Ford T, Russell G. (2015) Socioeconomic Associations with ADHD: Findings from a Mediation Analysis. *PLOS One*, June 1, 2015. DOI:10.1371/journal.pone.0128248
- Rutherford HJ, Booth CR, Crowley MJ & Mayes LC (2016). Investigating the relationship between working memory and emotion regulation in mothers. *Journal of Cognitive Psychology*, 28(1), 52–59. <https://doi.org/10.1080/20445911.2015.1075542>
- Rösler M, Retz W, Retz-Junginger P, Hengesch G, Schneider M, Supprian T, Schwitzgebel P, Pinhard K, Dovi-Akue N, Wender P, Thome J. (2004) Prevalence of attention deficit-/hyperactivity disorder (ADHD) and comorbid disorders in young male prison inmates. *Eur Arch Psychiatry Clin Neurosci*. 2004 Dec;254(6):365-71. DOI: 10.1007/s00406-004-0516-z
- Sanchez-Roige S, Fontanillas P, Elson SL (2019) 23andMe Research Team, Gray JC, de Wit H, Davis LK, MacKillop J, Palmer AA. Genome-wide association study of alcohol use disorder identification test (AUDIT) scores in 20 328 research participants of European ancestry. *Addiction biology*. 2019 Jan;24(1):121-31. DOI: 10.1111/adb.12574
- Schechter DS & Willheim E (2009). "Disturbances of attachment and parental psychopathology in early childhood". *Child and Adolescent Psychiatric Clinics of North America*. 18 (3): 665–86. DOI: 10.1016/j.chc.2009.03.001. 1.
- Schiweck C, Arteaga-Henriquez G, Aichholzer M, Thanarajah SE, Vargas-Cáceres S, Matura S, Grimm O, Haavik J, Kittel-Schneider S, Ramos-Quiroga JA, Faraone SV, Reif A, (2021) Comorbidity of ADHD and adult bipolar disorder: A systematic review and meta-analysis, *Neuroscience & Biobehavioral Reviews*, Volume 124, 2021, Pages 100-123, ISSN 0149-7634, <https://doi.org/10.1016/j.neubiorev.2021.01.017>.

- Schreiber LR, Grant JE, & Odlaug BL (2012). Emotion regulation and impulsivity in young adults. *Journal of psychiatric research*, 46(5), 651-658. DOI:10.1016/j.jpsychires.2012.02.005
- Schweiger A, Abramovitch A, Doniger GM & Simon ES (2007). A clinical construct validity study of a novel computerized battery for the diagnosis of ADHD in young adults. *Journal of Clinical and Experimental Neuropsychology*, 29(1), 100–111. <https://doi.org/10.1080/13803390500519738>
- Schweitzer JB, Lee DO, Hanford RB, Zink CF, Ely TD, Tagamets MA, Hoffman JM, Grafton ST, and Kilts CD (2004) Effect of Methylphenidate on Executive Functioning in Adults with Attention-Deficit/Hyperactivity Disorder: Normalization of Behavior but Not Related Brain Activity. *BIOL PSYCHIATRY* 2004;56:597– 606 doi:10.1016/j.biopsych.2004.07.011
- Seguin JR, Pihl RO, Harden PW, Tremblay RE & Boulerice B (1995). Cognitive and neuropsychological characteristics of physically aggressive boys. *Journal of Abnormal Psychology*, 104, 614. <https://doi.org/10.1037/0021-843X.104.4.614>
- Seidman LJ (2006). Neuropsychological functioning in people with ADHD across the lifespan. *Clinical Psychology Review*, 26, 466–485. DOI: 10.1016/j.cpr.2006.01.004
- Shanahan MA, Pennington BF, Yerys BE, Scott A, Boada R, Willcutt EG, ...DeFries JC (2006). Processing speed deficits in attention deficit/hyperactivity disorder and reading disability. *Journal of Abnormal Child Psychology*, 34, 584. DOI: 10.1007/s10802-006-9037-8
- Shaw P, Stringaris A, Nigg J, Leibenluft E (2014) Emotion dysregulation in attention deficit hyperactivity disorder. *Am J Psychiatry*, 2014. 171(3): p. 276-93. DOI: 10.1176/appi.ajp.2013.13070966
- Sheehan DV, Lecrubier Y, Sheehan KH, Janavs J, Weiller E, Keskiner A, Schinka J, Knapp E, Sheehan MF, Dunbar GC (1997) The validity of the Mini International Neuropsychiatric Interview (MINI) according to the SCID-P and its reliability. *Eur Psychiatry* 1997;12:232–41. DOI: 10.1016/S0924-9338(97)83297-X
- Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, Hergueta T, Baker R, Dunbar GC. (1998) The Mini-International Neuropsychiatric Interview (MINI): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *The Journal of clinical psychiatry*. 1998. 59 Suppl 20: 22–33. DOI: 10.1037/t18597-000
- Shifrin JG, Proctor BE, Prevatt FF. (2010) Work Performance Differences Between College Students With and Without ADHD. *J. of Attention Disorders*. 2010; 13(5) 489-496 DOI: 10.1177/1087054709332376
- Silva D, Colvin L, Glauert R & Bower C (2014). Contact with the juvenile justice system in children treated with stimulant medication for attention deficit hyperactivity disorder: a population study. *The Lancet Psychiatry*, 1(4), 278-285. DOI: 10.1016/S2215-0366(14)70302-5
- Silverstein MJ, Faraone SF, Alperin S, Biederman J, Spenser TJ, Adler LA (2017): How Informative Are Self-Reported Adult Attention-Deficit/Hyperactivity Disorder Symptoms? An Examination of the Agreement Between the Adult Attention-Deficit/

Hyperactivity Disorder Self-Report Scale V1.1 and Adult Attention Deficit/
Hyperactivity Disorder Investigator Symptom Rating Scale. *J Child Adolesc
Psychopharmacol.* 2017 Nov 27. DOI: 10.1089/cap.2017.0082.

- Silverstein MJ, Alperin S, Faraone SV, Kessler RC, and Adler LA: (2018) Test–retest reliability of the adult ADHD Self-Report Scale (ASRS) v1.1 Screener in non-ADHD controls from a primary care physician practice. *Family Practice*, Volume 35, Issue 3, June 2018, p336–341 DOI: 10.1093/fampra/cmx115
- Silverstein MJ, Faraone SV, Alperin S, Leon TL, Biederman J, Spencer TJ & Adler LA (2019) Validation of the Expanded Versions of the Adult ADHD Self-Report Scale v1.1 Symptom Checklist and the Adult ADHD Investigator Symptom Rating Scale. *Journal of Attention Disorders*, 23, 1101–1110. <https://doi.org/10.1177/1087054718756198>
- Silverstein MJ, Faraone SV, Leon TL, Biederman J, Spencer TJ & Adler LA (2020). The relationship between executive function deficits and DSM-5-defined ADHD symptoms. *Journal of Attention Disorders*, 24(1), 41–51. DOI: 10.1177/1087054718804347
- Skardhamar T (2014) Lifetime conviction risk—a synthetic cohort approach, *Journal of Scandinavian Studies in Criminology and Crime Prevention*, 2014, 15:1, 96-101, DOI: 10.1080/14043858.2014.883175
- Skirrow C & Asherson P (2013). Emotional lability, comorbidity and impairment in adults with attention-deficit hyperactivity disorder. *Journal of Affective Disorders*, 147(1–3), 80–86. <https://doi.org/10.1016/j.jad.2012.10.011>
- Sloan E, Hall K, Moulding R, Bryce S, Mildred H & Staiger PK (2017). Emotion regulation as a transdiagnostic treatment construct across anxiety, depression, substance, eating and borderline personality disorders: A systematic review. *Clin Psychol Rev*, 57, 141-163. doi:10.1016/j.cpr.2017.09.002
- Slomkowski C, Klein RG and Mannuzza S. (1995) Is Self-Esteem an Important Outcome in Hyperactive Children? *Journal of Abnormal Child Psychology*, Vol. 23, No. 3, 1995 DOI: 10.1007/BF01447559
- Sobanski E (2006) Psychiatric comorbidity in adults with attention-deficit/ hyperactivity disorder (ADHD). *Eur Arch Psychiatry Clin Neurosci.* 2006, Vol.256, pp.i26-i31 DOI: 10.1007/s00406-006-1004-4
- Sobanski E, Brüggemann D, Alm B, Kern S, Deschner M, Schubert T, Philipsen A, Rietschel M (2007) Psychiatric comorbidity and functional impairment in a clinically referred sample of adults with attention-deficit/hyperactivity disorder (ADHD). *Eur Arch Psychiatry Clin Neurosci.* 2007 Oct;257(7):371-7. DOI: 10.1007/s00406-007-0712-8
- Sobanski E, Banaschewski T, Chen W, Holtmann M, Asherson P, Stringaris A, Buitelaar J, Franke B, Sergeant J, Sonuga-Barke E, Taylor E, Ebstein R, Gill M, Miranda A, Oades R, Roeyers H, Rothenberger A, Steinhausen HC, Mulas F, Anney R, Krumm B, Faraone S. (2010) Emotional lability in children and adolescents with Attention Deficit / Hyperactivity Disorder (ADHD): Clinical correlates and familial prevalence. *Journal of Child Psychology and Psychiatry*, 2010, 51, 915-923 DOI: 10.1111/j.1469-7610.2010.02217.x
- Solberg BS, Halmøy A, Engeland A, Igeland J, Haavik J, Klungsøyr K: (2018) Gender differences in psychiatric comorbidity: a population-based study of 40 000 adults with

- attention deficit hyperactivity disorder. *Acta Psychiatrica Scandinavia* 2018; 137: 176-186 DOI: 10.1111/acps.12845
- Sourander A, Elonheimo H, Niemela S, Nuutila A-M, Helenius H, Sillanmaki L, Piha J, Tamminen T, Kumpulainen K, Moilanen I, AND Almqvist F. (2006) Childhood Predictors of Male Criminality: A Prospective Population-Based Follow-up Study From Age 8 to Late Adolescence. *J. Am. Acad. Child Adolesc. Psychiatry*, 2006; 45(5). DOI: 10.1097/01.chi0000205699.58626.b5
- SSB (2016) Statistics Norway. <http://www.ssb.no/294421/employed-persons-by-full-time-part-time-and-sex.2016.1-000-per-cent-and-average-contractual-usual-hours-per-week-sy-207>
- SSB (2018) Statistikkbanken: Table 06445
<https://www.ssb.no/statistikkbanken/selectvarval/define.asp?SubjectCode=al&ProductId=al&MainTable=SyssKjAldProsNY&contents=Sysselsatte&PLanguage=1&Qid=0&nvl=True&mt=1&pm=&SessID=14991528&FokusertBoks=1&gruppe1=Hele&gruppe2=Hele&gruppe3=Hele&gruppe4=Hele&VS1=Landet&VS2=Kjonn3&VS3=AlleAldre09dc&VS4=&CMSSubjectArea=arbeid-og-lonn&KortNavnWeb=regsys&StatVariant=&Tabstrip=SELECT&aggreseotr=1&checked=true>
- Storebø OJ, Rasmussen PD, & Simonsen E.: (2016) Association between insecure attachment and ADHD: environmental mediating factors. *Journal of attention disorders*, 2016. 20(2), 187-196. DOI: 10.1177/1087054713501079
- Stringaris A (2011). Irritability in children and adolescents: a challenge for the DSM 5. *European Child & Adolescent Psychiatry*, 20,61–66. <https://doi.org/10.1007/s00787-010-0150-4> DOI: 10.1007/s00787-010-0150-4
- Surman CB, Biederman J, Spencer T, Yorks D, Miller CA, Petty CR & Faraone SV (2011). Deficient emotional self-regulation and adult attention deficit hyperactivity disorder: A family risk analysis. *American Journal of Psychiatry*, 168, 617–623. <https://doi.org/10.1176/appi.ajp.2010.10081172>
- Surman CB, Biederman J, Spencer T, Miller CA, McDermott KM & Faraone SV (2013). Understanding deficient emotional self-regulation in adults with attention deficit hyperactivity disorder: A controlled study. *ADHD Attention Deficit and Hyperactivity Disorders*, Sep;5(3), 273– 281. <https://doi.org/10.1007/s12402-012-0100-8>
- Surman CB, Biederman J, Spencer T, Miller CA, Petty CR & Faraone SV (2015). Neuropsychological deficits are not predictive of deficient emotional self-regulation in adults with ADHD. *Journal of Attention Disorders*, 19, 1046–1053. <https://doi.org/10.1177/1087054713476548>
- Swanson JM, Schuck S, Porter MM, Carlson C, Hartman CA, Sergeant JA, Clevenger W, Wasdell M, McCleary R, Timothy W. (2012) Categorical and Dimensional Definitions and Evaluations of Symptoms of ADHD: History of the SNAP and the SWAN Rating Scales. *Int J Educ Psychol Assess*. 2012 April; 10(1): 51–70. PMID: 26504617
- Thaler NS, Bello DT & Etcoff LM (2013). (2013) WISC-IV profiles are associated with differences in symptomatology and outcome in children with ADHD. *Journal of Attention Disorders*, 17(4), 291–301. <https://doi.org/10.1177/1087054711428806>

- Thapar A, van den Bree M, Fowler T, Langley K, Whittinger N (2006) Predictors of antisocial behavior in children with attention deficit hyperactivity disorder *Eur Child Adolesc Psychiatry* (2006) 15:118–125 DOI: 10.1007/s00787-006-0511-1
- Thapar A, Langley K, Asherson P and Gill M. (2007) Gene–environment interplay in attention-deficit hyperactivity disorder and the importance of a developmental perspective. *The British journal of psychiatry* Volume 190, Issue 1 January 2007, 1-3. DOI: 10.1192/bjp.bp.106.027003
- Thapar A, Cooper M, Eyre O, Langley K (2013) Practitioner Review: What have we learnt about the causes of ADHD? *Journal of Child Psychology and Psychiatry* 54:1 (2013), pp 3–16 DOI: 10.1111/j.1469-7610.2012.02611.x
- Theiling J, Petermann F & Daseking M (2013). Relationship between self-reported ADHD symptoms and WAIS-IV performance. *Gesundheitswesen (Bundesverband Der Arzte Des Offentlichen Gesundheitsdienstes (Germany))*, 75, 768–774. DOI: 10.1055/s-0033-1357163
- Theiling J & Petermann F (2014). Neuropsychological profiles on the WAIS-IV of ADHD adults. *Journal of Attention Disorders*, 20, 913–924. DOI: 10.1177/1087054713518241
- Thomas R, Sanders S, Doust J, Beller E, Glasziou P. (2015) Prevalence of attention-deficit / hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics*, 2015 Apr, Vol.135(4):E994-E1001 doi: 10.1542/peds.2014-3482
- Thompson RA (1994). "Emotion Regulation: A Theme in Search of Definition". *Monographs of the Society for Research in Child Development*. 59 (2–3): 25–52. DOI:10.1111/j.1540-5834.1994.tb01276.x.
- Thorsen AL, Meza J, Hinshaw S & Lundervold AJ (2018). Processing speed mediates the longitudinal association between ADHD symptoms and preadolescent peer problems. *Frontiers in Psychology*, 8, 2154. <https://doi.org/10.3389/fpsyg.2017.02154>
- Tucha L, Fuermaier AB, Koerts J, Buggenthin R, Aschenbrenner S, Weisbrod M, Tucha O (2017). Sustained attention in adult ADHD: Time-on-task effects of various measures of attention. *Journal of Neural Transmission*, 124(S1), 39–53. DOI: 10.1007/s00702-015-1426-0
- Turner DC, Luke Clark, Jonathan Dowson, Trevor W Robbins, Barbara J. (2004) Modafinil improves cognition and response inhibition in adult attention-deficit/hyperactivity disorder. *Biological Psychiatry*, May 15, 2004 Volume 55, Issue 10, Pages 1031–1040 DOI: 10.1016/j.biopsych.2004.02.008
- Uderman JZ (2015) Working Memory Deficits and Emotion Dysregulation in Youth with Attention-Deficit/Hyperactivity Disorder: Understanding Relationships and Treatment Implications. *Academicworks.cuny.edu* 2015.
- Unnever JD & Cornell DG. (2003) Bullying, self-control, and ADHD. *Journal of interpersonal violence*. 2003 Feb;18(2):129-47. DOI: 10.1177/0886260502238731
- Usher AM, Stewart LA, Wilton G. (2013) Attention deficit hyperactivity disorder in a Canadian prison population. *International Journal of Law and Psychiatry*. Volume 36, Issues 3–4, May–August 2013, Pages 311-315 DOI: 10.1016/j.ijlp.2013.04.005

- van Emmerik-van Oortmerssen K, van de Glind G, van den Brink W, Smit F, Crunelle CL, Swets M & Schoevers RA (2012). Prevalence of attention-deficit hyperactivity disorder in substance use disorder patients: a meta-analysis and meta-regression analysis. *Drug and alcohol dependence*, 122(1-2), 11-19. DOI: 10.1016/j.drugalcdep.2011.12.007
- Vidal R, Valero S, Nogueira M, Palomar G, Corrales M, Richarte V, . . . Ramos-Quiroga JA (2014). Emotional lability: the discriminative value in the diagnosis of attention deficit/hyperactivity disorder in adults. *Compr Psychiatry*, 55(7), 1712-1719. DOI: 10.1016/j.comppsy.2014.07.001
- Vildalen VU, Brevik EJ, Haavik J, Lundervold AJ. (2019) Females with ADHD report more severe symptoms than males on the adult ADHD self-report scale. *Journal of attention disorders*. 2019 Jul;23(9):959-67. DOI: 10.1177/1087054716659362
- Vogel T, Dom G, van de Glind G, Studer J, Gmel G, Strik W & Moggi F (2016). Is attention deficit/hyperactivity disorder among men associated with initiation or escalation of substance use at 15-month follow-up? A longitudinal study involving young Swiss men. *Addiction*, 111(10), 1867-1878. DOI: 10.1111/add.13422
- von Polier GG, Vloet TD, Herpertz-Dahlmann B. (2012) ADHD and delinquency – a developmental perspective. *Behav Sci Law* 2012;30:121–39. DOI: 10.1002/bsl.2005
- Waite R (2010). Women with ADHD: It is an explanation, not the excuse du jour. *Perspectives in Psychiatric Care*, 46(3), 182-196. DOI: 10.1111/j.1744-6163.2010.00254.x
- Walker JT & Maddan S (2016). Understanding Statistics for the Social Sciences, *Criminal Justice, and Criminology*. Jones & Bartlett Publishers. p. 99. ISBN 1449634036. Retrieved August 7, 2016.
- Wang K, Gaitsch H, Poon H, Cox NJ, Rzhetsky A. (2017) Classification of common human diseases derived from shared genetic and environmental determinants. *Nature genetics*. 2017 Sep;49(9):1319-1325 DOI: 10.1038/ng.3931
- Ward MF, Wender PH, FW Reimherr (1993). The Wender Utah Rating Scale: an aid in the retrospective diagnosis of childhood attention deficit hyperactivity disorder. *Am J Psychiatry* 1993 Jun;150(6):885-90. DOI: 10.1176/ajp.150.6.885
- Wechsler D (1997) The Wechsler Adult Intelligence Scale (3rd ed.). San Antonio, TX: Psychological Corporation.
- Wechsler D, Nyman H & Nordvik H (2003). WAIS-III: Wechsler Adult Intelligence Scale Manual. Norsk Versjon. Stockholm, Sweden: Psykologiforlaget.
- Wechsler D, Coalson DL & Raiford SE (2008). WAIS-IV technical and interpretive manual. San Antonio, TX: Pearson.
- Wender PH (1971) Minimal Brain Dysfunction in Children. Wiley-Interscience; 1971. *Wiley Series on Personality Disorders*; Weiner IB ed.
- Wender PH (1995) Attention Deficit/Hyperactivity Disorder in Adults. New York, NY: Oxford University press.
- Wender PH, Wolf LE & Wasserstein J (2001). Adults with ADHD: An overview. *Annals of the New York academy of sciences*, 931(1), 1-16. PMID: 11462736

- WHO, World Health Organization (1965) 8th International Classification of Diseases (ICD-8) of the World Health Organization
- WHO, World Health Organization (1977) 9th International Classification of Diseases (ICD-9) of the World Health Organization
- WHO, World Health Organization (1992) 10th International Classification of Diseases (ICD-10) of the World Health Organization
- WHO, World Health Organization (2003): Adult ADHD Self-Report Scale-V1. 1 (ASRS-V1. 1) Symptom Checklist. Retrieved from WHO Composite International Diagnostic Interview.
- WHO, World Health Organization (2007): Adult ADHD Self-Report Scale-V1.1 (ASRS-V1.1) Symptoms Checklist from WHO. Composite International Diagnostic Interview.
- WHO World Health Organization (2012): RISKS TO MENTAL HEALTH: AN OVERVIEW OF VULNERABILITIES AND RISK FACTORS BACKGROUND PAPER BY WHO SECRETARIAT FOR THE DEVELOPMENT OF A COMPREHENSIVE MENTAL HEALTH ACTION PLAN 27AUGUST 2012 This WHO Discussion Paper does not represent an official position of WHO.
- Wilens TE. (2004) Impact of ADHD and its treatment on substance abuse in adults. *Journal of Clinical Psychiatry*. 2004 Mar 1;65:38-45. PMID: 15046534
- Wilens TE, Adamson J, Sgambati S, Whitely J, Santry A, Monuteaux MC & Biederman J (2007) Do individuals with ADHD self-medicate with cigarettes and substances of abuse? Results from a controlled family study of ADHD. *Am J Addict* 2007, 16 (Suppl.1):14–21. DOI: 10.1080/10550490601082742
- Wilens TE (2007) The nature of the relationship between attention-deficit/hyperactivity disorder and substance use. *The Journal of clinical psychiatry*. 2007; 68:4-8. PMID: 18307375
- Willcutt EG, Nigg JT, Pennington BF, Solanto MV, Rohde LA, Tannock R, Loo SK, Carlson CL, McBurnett K, Lahey BB. (2012) Validity of DSM-IV attention deficit/hyperactivity disorder symptom dimensions and subtypes. *Journal of Abnormal Psychology*, 2012. 121(4), 991-1010. DOI: 10.1037/a0027347
- Willcutt EG, Doyle AE, Nigg JT, Faraone SV & Pennington BF (2015). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, 57, 1336–1346. doi:10.1016/j.biopsych.2005.02.006
- Williamson D & Johnson C (2015) Gender differences in adults with attention-deficit/hyperactivity disorder: A narrative review; *Clinical Psychology Review* 40 (2015) 15-27 DOI: 10.1016/j.cpr.2015.05.005
- Wood DR, Reimherr FW, Wender PH & Johnson GE (1976). Diagnosis and treatment of minimal brain dysfunction in adults: a preliminary report. *Archives of General Psychiatry*, 33(12), 1453-1460. DOI:10.1001/archpsyc.1976.01770120057005
- Woods SP, Lovejoy DW & Ball JD (2002). Neuropsychological characteristics of adults with ADHD: A comprehensive review of initial studies. *The Clinical Neuropsychologist*, 16(1), 12– 34. DOI:10.1076/clin.16.1.12.8336

- Yang P, Cheng CP, Chang CL, Liu TL, Hsu HY & Yen CF (2013). Wechsler Intelligence Scale for Children 4th edition-Chinese version index scores in Taiwanese children with attention- deficit/hyperactivity disorder. *Psychiatry and Clinical Neurosciences*, 67(2), 83–91. DOI: 10.1111/pcn.12014
- Young S & Gudjonsson GH. (2006) ADHD symptomatology and its relationship with emotional, social and delinquency problems. *Psychology, Crime & Law*. 2006 Oct 1;12(5):463-71. DOI: 10.1080/10683160500151183
- Young S (2007). Forensic aspects of ADHD. Handbook of attention deficit hyperactivity disorder, Fitzgerald M, Bellgrove M, Gill M (Eds). *Wiley, Chichester, UK*, 91–108
- Young S & Thome J. (2011) ADHD and offenders. *World J Biol Psychiatry* 2011;12(Suppl 1):124–8. DOI: 10.3109/15622975.2011.600319
- Young S, Moss D, Sedgwick O, Fridman M, Hodgkins P. (2015) A meta-analysis of the prevalence of attention deficit hyperactivity disorder in incarcerated populations. *Psychol Med*. (2015) Jan;45(2):247-58. DOI: 10.1017/S0033291714000762
- Young JT, Carruthers S, Kaye S, Allsop S, Gilsenan J, Degenhardt L, van de Glind G, van den Brink W, Preen D. (2015) Comorbid attention deficit hyperactivity disorder and substance use disorder complexity and chronicity in treatment-seeking adults. *Drug Alcohol Rev* 2015; 34:683–93 DOI: 10.1111/dar.12249
- Ziobrowski H, Brewerton TD, Duncan AE (2018) Associations between ADHD and eating disorders in relation to comorbid psychiatric disorders in a nationally representative sample. *Psychiatry Res*. 2018 Feb;260:53-59. DOI: 10.1016/j.psychres.2017.11.026.

Appendix: Paper I, II, III, IV and V:

BMJ Open Comorbid psychiatric disorders in a clinical sample of adults with ADHD, and associations with education, work and social characteristics: a cross-sectional study

Espen Anker,¹ Bothild Bendiksen,² Trond Heir³

To cite: Anker E, Bendiksen B, Heir T. Comorbid psychiatric disorders in a clinical sample of adults with ADHD, and associations with education, work and social characteristics: a cross-sectional study. *BMJ Open* 2018;**8**:e019700. doi:10.1136/bmjopen-2017-019700

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2017-019700>).

All authors contributed equally to this paper.

Received 21 September 2017
Revised 11 December 2017
Accepted 30 January 2018

ABSTRACT

Objectives Adults with attention-deficit hyperactive disorder (ADHD) report high rates of comorbid disorders, educational and occupational failure, and family instability. The aim of this study was to examine the prevalence of comorbid psychiatric disorders in a clinical population of adults with ADHD and to examine associations between educational level, work participation, social characteristics and the rates of psychiatric comorbidity.

Methods Out of 796 patients diagnosed with ADHD in a specialised outpatient clinic in Oslo, Norway, 548 (68%) agreed to participate in this cross-sectional study: 277 women and 271 men. ADHD was diagnosed according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria. Comorbid disorders were diagnosed using the Mini-International Neuropsychiatric Interview.

Results In this clinical sample, 53.5% had at least one current comorbid psychiatric disorder. The most prevalent disorders were major depression, substance use disorders and social phobia. Women had more eating disorders than men, whereas men had more alcohol and substance use disorders. Education above high school level (>12 years) and work participation were associated with lower rates of comorbid disorders (adjusted ORs 0.52 and 0.63, respectively). Gender, age, marital status, living with children or living in a city were not associated with comorbidity.

Conclusions Adult ADHD is associated with high rates of comorbid psychiatric disorders, irrespective of gender and age. It appears that higher education and work participation are related to lower probability of comorbidity.

INTRODUCTION

Attention-deficit hyperactive disorder (ADHD) is a neuropsychiatric disorder with core symptoms of inattention, hyperactivity and impulsivity.¹ The population prevalence of adult ADHD is reported to be 3%–5%.^{2–3} Adult ADHD causes impairment and suffering.^{4,5} Also, various comorbidities in the sense of additional psychiatric disorders are associated with considerable functional impairment and burden to family and society.²

Strengths and limitations of this study

- The study had a naturalistic design, recruiting adult patients with attention-deficit hyperactive disorder from a large area and with no exclusion criteria.
- Rate of consent and the number of participants were high.
- Private clinics may recruit patients with higher social status resulting in a selection bias.

The prevalence of psychiatric disorders other than ADHD is higher in adults with ADHD than in the general population, with rates of comorbid disorders ranging from 47% to 89% in various clinical samples.^{6–12} The most commonly reported comorbid disorders are drug abuse, anxiety disorders and mood disorders.^{10–11} There is some evidence of gender differences, with women reporting higher rates of mood disorders, panic disorder, eating disorders and somatisation, although these findings are not entirely consistent.^{8–13–14} In comparison, men with ADHD have higher prevalence of drug abuse.^{8–14}

Social surroundings, such as spouse and children, and socioeconomic circumstances, such as education, work and income, are important aspects of mental health.¹⁵ Low socioeconomic status, lower education, unemployment, marital disruption or family difficulties are associated with higher prevalence of psychiatric disorders in the general population.^{16–20} Adults with ADHD have lower education and higher rates of unemployment than the general population,^{21–22} and they have more family instability over time.²³ Still, we have found few studies that have examined whether or to what extent social characteristics are associated with comorbid psychiatric disorders in adults with ADHD.



¹Oslo ADHD Clinic, Oslo, Norway
²Institute of Clinical Medicine, University of Oslo, Oslo, Norway
³Institute of Clinical Medicine, University of Oslo, Oslo, Norway

Correspondence to

Dr Espen Anker;
espen.anker@online.no

In a German study of adult patients with ADHD, those with a lifetime diagnosis of a comorbid psychiatric disorder were more often unemployed than patient with pure ADHD.⁶ However, patients with and without comorbidity did not differ in education or partnership functioning. Due to the limited number of patients assessed (n=70), the authors emphasised the need for studies with larger sample size.

In accordance with findings in the general population, we hypothesised that social surroundings such as family and children, and socioeconomic circumstances such as education and work, are associated with comorbid psychiatric disorders in patients with ADHD. We aimed to estimate the prevalence of comorbid psychiatric disorders in a clinical population of adults diagnosed with ADHD. Then, we wanted to examine whether gender, age and social characteristics, such as marital status, living with children, living in a city, level of education and occupational status were associated with rates of comorbidity.

METHODS

Participants

The study sample consisted of adult patients who fulfilled the criteria for ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).¹ They were admitted to a private outpatient clinic in Oslo, Norway, that is specialised in medical examinations and treatment of ADHD. Recruitment was conducted in the years from 2005 to 2015. During these years, a total of 796 patients were found to meet the diagnostic criteria of ADHD and asked to participate in the study. The patients were self-referred (65%) or referred by general physicians, specialists or neuropsychologist (35%).

Out of 796 patients with ADHD, 533 actively consented to participate in the study. Also included, with approval of the Regional Medical Ethics Committee, were 15 patients who had died after the examination. In total, 548 patients were included (68.8%). Assessments and handling of data were carried out in accordance with ethical standards and the principles of the Declaration of Helsinki.

Measures

A psychiatric examination was undertaken for all patients included in the study. All patients had prior to assessment either been to a neuropsychological examination, or examined by a special educational teacher with experience and expertise in the use of Wechsler Adult Intelligence Scale-III (WAIS-III)²⁴ and ADHD. These have concluded with concentration and attention deficiency, and evidence of ADHD. Finally, the diagnosis of ADHD required six out of nine symptoms of inattention or six out of nine symptoms of hyperactivity or impulsivity present for at least 6 months prior to assessment, causing impairment, according to the diagnostic manuals of DSM-IV.¹ The symptoms must cause significant impairment in social, academic or occupational functioning.

Furthermore, some hyperactive, impulsive or inattentive symptoms must have been present before age of 7 years. Parents, teachers or other relevant persons were interviewed about the patients' childhood, when possible, to confirm whether they met the criteria for ADHD in childhood. We recorded if the patient fulfilled the criteria for predominantly inattentive type—attention-deficit disorder (ADD), predominantly hyperactive-impulsive type—hyperactive disorder (HD) or combined type—ADHD.¹

Age, sex, educational background, occupational and marital status and whether they were living with children and lived in or outside Oslo city were recorded. Comorbid disorders were diagnosed using the Mini-International Neuropsychiatric Interview (M.I.N.I.), which is a brief and valid structured clinical interview.²⁵ This interview enables researchers to make diagnoses of psychiatric disorders according to DSM-IV criteria.¹ We used the Norwegian version of the M.I.N.I., V.5.0.0., that has been validated in clinical settings and has shown good psychometric properties.^{26 27}

IQ was measured in a subsample of participants (n=341), using the WAIS-III test.²⁴

Statistical analysis

We performed χ^2 tests or Student's t-test to compare socio-demographic characteristics of participants and non-participants, and to compare rates of comorbidity in men and women, and in diagnostic subgroups of ADHD. We used logistic regression analyses to examine associations between levels of education, work participation and social characteristics, and rates of comorbidity. Confounding effects of IQ were tested in a subsample. All tests were two tailed and differences were considered significant if $P < 0.05$. All statistical analyses were done using the software package SPSS V.22.

RESULTS

Table 1 shows levels of education, work participation and social characteristics of participants. Participants had higher age and higher education than non-participants, and more participants were living with children and in urban areas (data not shown).

Table 2 shows current comorbid psychiatric disorders among the participants. Half of both women and men had at least one comorbid disorder, and a quarter had at least two comorbid disorders. The most prevalent comorbid disorders were major depression, substance abuse or dependence and social phobia. There were some gender differences. More women had bulimia or anorexia, and more men had alcohol and substance use disorders. Substance dependence was the most prevalent comorbid disorder in men, whereas major depression was the most prevalent one in women.

When divided into subtypes, 74 (13.5%) of the patients had the predominantly inattentive type (ADD), none had the predominantly hyperactive-impulsive type (HD) and

Table 1 Demographic description of adult patients diagnosed with attention-deficit hyperactive disorder (ADHD) in a psychiatric clinic specialised in examination and treatment of ADHD

	Women, n=271 (50.5)	Men, n=277 (49.5)	All (N=548)
Age			
Mean years (SD)	36.2 (11.3)	37.4 (10.7)	36.6 (11.0)
Range years	18–69	18–67	18–69
Married/cohabitant, n (%)			
Yes	112 (41.3)	126 (45.5)	238 (43.4)
No	159 (58.7)	151 (55.5)	310 (56.6)
Living with children, n (%)			
Yes	98 (36.2)***	149 (53.8)	247 (45.1)
No	173 (63.8)	128 (46.2)	301 (54.9)
Years of education, n (%)			
>15	23 (8.5)	25 (9.0)	48 (8.8)
13–15	95 (35.1)	110 (39.7)	205 (37.4)
≤12	153 (56.5)	142 (51.3)	295 (53.8)
Working, n (%)			
Yes	176 (64.9)*	155 (56.0)	331 (60.4)
No	95 (35.1)	122 (44.0)	217 (39.6)
Residence, n (%)			
City	176 (64.1)	168 (60.6)	380 (69.3)
Rural	95 (35.1)	109 (39.4)	168 (30.7)

* $p < 0.05$ and *** $P < 0.001$ (women compared with men).

473 (86.3%) had the combined type. Participants with the combined type had higher prevalence of comorbid disorders (55.7%) than those with the predominantly inattentive type (39.2%, $P = 0.008$).

Table 3 shows the association between levels of education, work and social characteristics, and the occurrence of any current comorbid psychiatric disorder. Higher education and work participation were associated with lower probability of comorbidity. Gender, age and whether the patients were married or cohabitant, or whether they were living with children, or living in Oslo versus more rural areas outside Oslo, were not significantly associated with comorbidity.

Analyses in a subsample of participants that had data on IQ ($n = 341$) revealed no significant association between IQ and comorbidity (OR 1.01, 95% CI 0.97 to 1.06, $P = 0.62$). IQ had no confounding effects in models of multiple logistic regression (data not shown). Also, IQ was not significantly associated with levels of education or work participation. There were no significant differences between the IQ subsample and the non-IQ subsample in gender, age or any of the social characteristics.

Regarding individual diagnoses, higher education was associated with lower risk of social phobia (OR: 0.67 95% CI 0.50 to 0.97, $P = 0.033$). Work participation was associated with lower risk of major depression (OR 0.58,

95% CI 0.37 to 0.91, $P = 0.017$), substance abuse (OR 0.29, 95% CI 0.10 to 0.84, $P = 0.022$), substance dependence (OR 0.44, 95% CI 0.28 to 0.69, $P < 0.001$) and post-traumatic stress disorder (OR 0.52, 95% CI 0.31 to 0.87, $P = 0.013$).

DISCUSSION

In this clinical sample of adults with ADHD, about half of the participants had at least one comorbid psychiatric disorder, irrespective of gender and age. The most prevalent disorders were major depression, substance use disorders and social phobia. Women had more eating disorders than men, whereas men had more alcohol and substance use disorders. Higher education and work participation were associated with lower probability of comorbidity.

Prevalence of comorbid disorders

The 50% prevalence of a comorbid mental disorder was similar or in the lower range of what was found in other studies of adults with ADHD.^{6–12} The disorders in question are the same as those common in the general population, but appeared to exist to a greater extent.²⁸ In fact, the point prevalence of a comorbid psychiatric disorder was about twice as high in this study, as an average 12 months prevalence of common mental disorders in the general population of various Western countries.^{17 29–32}

Education and work

The high comorbidity of mental disorders in people with ADHD may have several reasons, such as coinciding genetic dispositions for mental disease, increased psychological vulnerability due to ADHD symptomology or lower resilience due to adverse social or socioeconomic consequences of ADHD. Our results are most relevant to the possible effects of social and socioeconomic factors. The finding that unemployment was associated with higher probability of psychiatric comorbidity is in accordance with a German study that showed that patients with ADHD with a lifetime diagnosis of a comorbid psychiatric disorder were more often unemployed than patient with pure ADHD.⁶ Unlike that study, we found that education was also related to psychiatric comorbidity. Both findings make sense when compared with evidence from general population studies. Psychiatric morbidity is more common among unemployed and people with less education,^{28 32 33} and rates of almost all psychiatric disorders decline with increased income and education.³⁴

Some authors have suggested that educational attainment may represent a proxy for IQ because individuals with higher IQs stay longer within education.³⁵ In our study, however, the relationship between education and comorbid mental illness was independent of IQ, and IQ was poorly related to comorbidity. Although the assessment of IQ was limited to a smaller sample, our findings indicate that there may be other factors that are more important for educational attainment in people with

Table 2 Prevalence of current comorbid disorders in a clinical population of 548 adult patients diagnosed with attention-deficit hyperactive disorder

	Women, n=277	Men, n=271	Total, N=548
Major depression	48 (17.3)	47 (17.3)	95 (17.3)
Suicidality	15 (5.4)	12 (4.4)	27 (4.9)
Social phobia	41 (14.8)	37 (13.7)	78 (14.2)
Agoraphobia	20 (7.2)	5 (1.9)	25 (4.6)
Panic disorder	14 (5.1)	11 (4.1)	25 (4.6)
General anxiety disorder	17 (6.1)	11 (4.1)	28 (5.1)
Post-traumatic stress disorder	40 (14.4)	25 (9.2)	65 (11.9)
Alcohol abuse	1 (0.4)	4 (1.5)	5 (0.9)
Alcohol dependence	11 (4.0)*	27 (10.0)	38 (6.9)
Substance abuse	2 (0.7)*	14 (5.2)	16 (2.9)
Substance dependence	26 (9.4)***	64 (23.6)	90 (13.5)
Bulimia/anorexia	36 (13.0)***	3 (1.1)	39 (7.1)
Obsessive-compulsive disorder	18 (6.5)	14 (5.2)	32 (5.8)
Bipolar disorder	32 (11.6)	23 (8.5)	55 (10.0)
Psychotic disorder	4 (1.4)	9 (3.3)	13 (2.4)
At least one comorbid disorder	151 (54.5)	142 (52.4)	293 (53.5)
At least two comorbid disorders	70 (25.3)	56 (21.0)	126 (23.0)

Figures are given as numbers (percentages). All diagnoses are done according to Mini-International Neuropsychiatric Interview.

* $p < 0.01$; *** $P < 0.001$ (women compared with men).

ADHD than intelligence, and that intelligence does not protect against comorbid mental illness.

Work and educational success may increase income and social status and serve as important arenas for investment in social capital, all important for prevention of mental illness. It is also possible that individuals with a current comorbid mental disorder have a previous history of mental illness that made it harder to get education and work. Socioeconomic factors and mental health may have interfered with each other in a dynamic process that has affected education, work performance and the probability of mental illness.

Individual disorders

Some diagnoses such as major depression, bipolar disorder, substance use disorders and eating disorders appeared to be far more common than what has been found in the general Norwegian population.³² The reason may vary for various disorders. While inadequacy in coping with life stressors has repeatedly been proposed as a theory of depression,^{36,37} a need for self-medication to alleviate ADHD symptoms has been suggested to explain the relationship between ADHD and substance use.^{38,39} Our findings suggest that getting a job can be preventive to both depression and substance use disorders, or the

Table 3 Risk of at least one current comorbid psychiatric disorders in a clinical sample of 548 adult patients with attention-deficit hyperactive disorder (logistic regression)

	Crude/unadjusted		Adjusted	
	OR (95% CI)	P value	OR (95% CI)	P value
Sex (female vs male)	1.09 (0.78 to 1.52)	0.62	1.04 (0.73 to 1.48)	0.85
Age (increase in 10 years)	1.05 (0.90 to 1.23)	0.52	1.11 (0.94 to 1.32)	0.22
Marriage/cohabitant (yes vs no)	0.78 (0.56 to 1.10)	0.15	0.75 (0.50 to 1.13)	0.16
Living with children (yes vs no)	1.03 (0.73 to 1.44)	0.87	1.35 (0.88 to 2.09)	0.17
Living in Oslo (yes vs no)	1.08 (0.77 to 1.52)	0.67	1.13 (0.78 to 1.64)	0.51
Education				
≤12 (Reference)	–	–	–	–
13 – 15	0.57 (0.40 to 0.82)	0.003	0.56 (0.39 to 0.81)	0.002
>15	0.32 (0.17 to 0.61)	0.001	0.33 (0.17 to 0.63)	0.001
Working (yes vs no)	0.65 (0.46 to 0.92)	0.015	0.63 (0.43 to 0.92)	0.018

disorders may coincide with previously reduced health which has affected the ability to work.

The gender differences in our study, with more eating disorders among women and more alcohol and substance use disorders among men, are in line with evidence from other ADHD comorbidity studies.^{8 14} The gender differences are like those in the general population.^{28 32 34} Conceptually, it is impossible to know to what extent they are unique to ADHD or simply reflect general population patterns of gender-specific aetiology.⁴⁰

Methodological considerations

Benefits of the study include a naturalistic design with inclusion of patients admitted to examination or treatment of ADHD; they were recruited from a large area and over a long period of time. There have been no exclusion criteria; each individual who met the ADHD criteria was asked to participate in the study. The rate of consent and the number of participants were high.

Some limitations of this study should be noted. First, the cross-sectional design does not allow conclusions about causality. Future longitudinal studies are needed to explore the nature of the association between education, work participation and mental health in people with ADHD. Second, the inclusion of patients attended to a private ADHD clinic questions the representativeness of the study sample for the adult population with ADHD in general. Some adults with ADHD never come to medical examination at all; others are referred to the public health service. Private clinics may recruit patients with higher social status and better finances. Compared with patients with ADHD in the Norwegian public health service,¹⁰ our participants had greater participation rate in work and less comorbid disorders. However, we believe that bias in the sample selection may primarily affect the frequency estimates of socioeconomic factors or comorbid disorders and to a lesser extent their relationship.^{41 42} Third, we restricted our examination to 16 axis I DSM-IV disorders that are common in the general population²⁵ and do not know if other comorbid psychiatric disorders may exist in adult people with ADHD. For example, we have no information about personality disorders. Finally, we did not collect data on income and wealth. Such data might indicate whether it was the work in itself, or what it caused by financial benefits that was related to mental health.

Implications

Clinicians should be aware of high rates of comorbid mental disorders in adults with ADHD. Symptoms of comorbid mental disorders may complicate the examination of ADHD or the evaluation of treatment. In other cases, it may be complicated to detect and treat comorbid disorders because symptoms are obscured by ADHD symptomatology. It has been suggested that people with ADHD should be screened for depression, anxiety and substance use.⁴³ Another suggestion is that clinicians should consider ADHD evaluation and treatment as part of the management of substance use disorders.³⁹

Likewise, the presence of treatment-resistant depression should attract attention to a possible presence of ADHD.⁴⁴

There is convincing evidence that social capital is protective against developing common mental disorders,⁴⁵ which may be equally valid for people with ADHD. People with ADHD report inferior educational and occupational attainment.^{21 22 46} In the present sample of patients with ADHD, 60% had work compared with 70%–80% of adults in the Norwegian general population.⁴⁷ In other Norwegian populations of adult patients with ADHD, work participation has been even lower, ranging from 24%⁴⁶ to 44%.¹⁰

Thus, there is reasonable evidence to implement and evaluate interventions to facilitate education and work participation in people with ADHD. The effectiveness of such intervention in preventing mental disorders should be evaluated in longitudinal studies.

Acknowledgements We especially want to thank Christina Bjercke for performing 341 WAIS tests, and Jan Haavik for good advices.

Contributors EA and TH designed the study. EA collected and analysed the data. All authors participated actively in the writing of the manuscript and approved the final draft.

Funding This work was supported by the Norwegian Medical Association.

Competing interests None declared.

Patient consent Obtained.

Ethics approval The Regional Medical Ethics Committee, Southeast Norway, approved this study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Data are from a private psychiatric outward in Oslo. Public availability would compromise privacy of the respondents. According to the approval from the Norwegian Regional Committees for Medical and Health Research Ethics, the data are to be stored properly and in line with the Norwegian Law of privacy protection. However, anonymised data are freely available to interested researchers on request, pending ethical approval from our Ethics committee. Interested researchers can contact project leader Espen Anker (espen.anker@online.no) with requests for the data underlying our findings.

Open Access This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

© Article author(s) (or their employer(s) unless otherwise stated in the text of the article) 2018. All rights reserved. No commercial use is permitted unless otherwise expressly granted.

REFERENCES

1. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. Fourth Edn. Washington, DC: American Psychiatric Association, 2004. Text Revision.
2. Fayyad J, De Graaf R, Kessler R, *et al*. Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *Br J Psychiatry* 2007;190:402–9.
3. Kessler RC, Adler L, Barkley R, *et al*. The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *Am J Psychiatry* 2006;163:716–23.
4. Kooij SJ, Bejerot S, Blackwell A, *et al*. European consensus statement on diagnosis and treatment of adult ADHD: The European Network Adult ADHD. *BMC Psychiatry* 2010;10:67.
5. Thomas R, Sanders S, Doust J, *et al*. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 2015;135:e994–1001.

6. Sobanski E. Psychiatric comorbidity in adults with attention-deficit/hyperactivity disorder (ADHD). *Eur Arch Psychiatry Clin Neurosci* 2006;256:i26–31.
7. Jacob CP, Romanos J, Dempfle A, et al. Co-morbidity of adult attention-deficit/hyperactivity disorder with focus on personality traits and related disorders in a tertiary referral center. *Eur Arch Psychiatry Clin Neurosci* 2007;257:309–17.
8. Cumyn L, French L, Hechtman L. Comorbidity in adults with attention-deficit hyperactivity disorder. *Can J Psychiatry* 2009;54:673–83.
9. Garcia CR, Bau CH, Silva KL, et al. The burdened life of adults with ADHD: impairment beyond comorbidity. *Eur Psychiatry* 2012;27:309–13.
10. Fredriksen M, Dahl AA, Martinsen EW, et al. Effectiveness of one-year pharmacological treatment of adult attention-deficit/hyperactivity disorder (ADHD): an open-label prospective study of time in treatment, dose, side-effects and comorbidity. *Eur Neuropsychopharmacol* 2014;24:1873–84.
11. Piñero-Dieguez B, Balanzá-Martínez V, García-García P, et al. Psychiatric comorbidity at the time of diagnosis in adults with ADHD: the CAT study. *J Atten Disord* 2016;20:1066–75.
12. Anastopoulos AD, DuPaul GJ, Weyandt LL, et al. Rates and patterns of comorbidity among first-year college students with ADHD. *J Clin Child Adolesc Psychol* 2016;6:1–12.
13. Biederman J, Ball SW, Monuteaux MC, et al. New insights into the comorbidity between ADHD and major depression in adolescent and young adult females. *J Am Acad Child Adolesc Psychiatry* 2008;47:426–34.
14. Rasmussen K, Levander S. Untreated ADHD in adults: are there sex differences in symptoms, comorbidity, and impairment? *J Atten Disord* 2009;12:353–60.
15. World Health Organization. *Risk to mental health: an overview of vulnerabilities and risk factors. Background paper by WHO secretariat for the developing of a comprehensive mental health action plan.* Geneva: World Health Organization, 2012.
16. Inaba A, Thoits PA, Ueno K, et al. Depression in the United States and Japan: gender, marital status, and SES patterns. *Soc Sci Med* 2005;61:2280–92.
17. Kessler RC, Chiu WT, Demler O, et al. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry* 2005;62:617–27.
18. Andersen I, Thielen K, Nygaard E, et al. Social inequality in the prevalence of depressive disorders. *J Epidemiol Community Health* 2009;63:575–81.
19. Green MJ, Benzeval M. The development of socioeconomic inequalities in anxiety and depression symptoms over the lifecourse. *Soc Psychiatry Psychiatr Epidemiol* 2013;48:1951–61.
20. Paananen R, Ristikari T, Merikukka M, et al. Social determinants of mental health: a Finnish nationwide follow-up study on mental disorders. *J Epidemiol Community Health* 2013;67:1025–31.
21. Ebejer JL, Medland SE, van der Werf J, et al. Attention deficit hyperactivity disorder in Australian adults: prevalence, persistence, conduct problems and disadvantage. *PLoS One* 2012;7:e47404.
22. Küpper T, Haavik J, Drexler H, et al. The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. *Int Arch Occup Environ Health* 2012;85:837–47.
23. Jaber L, Kirsh D, Diamond G, et al. Long-term functional outcomes in Israeli adults diagnosed in childhood with attention deficit hyperactivity disorder. *Isr Med Assoc J* 2015;17:481–5.
24. Kaufman AS. *The essentials of WAIS-III assessment.* Hoboken, NJ: John Wiley, 1999. Essentials of psychological assessment series.
25. Sheehan DV, Lecrubier Y, Sheehan KH, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry* 1998;59:22–33.
26. Leiknes KA, Leganger S, Malt EA, et al. *MINI International Neuropsychiatric Interview (1992–2009). MINI Internasjonal neuropsykiatrisk intervju, Norwegian version 5.0.0 and 6.0.0.* Norway: Norwegian-Mapi Research Institute.
27. Mordal J, Gundersen O, Bramness JG. Norwegian version of the Mini-International Neuropsychiatric Interview: feasibility, acceptability and test-retest reliability in an acute psychiatric ward. *Eur Psychiatry* 2010;25:172–7.
28. Baumeister H, Härter M. Prevalence of mental disorders based on general population surveys. *Soc Psychiatry Psychiatr Epidemiol* 2007;42:537–46.
29. Andrews G, Henderson S, Hall W. Prevalence, comorbidity, disability and service utilisation. Overview of the Australian National Mental Health Survey. *Br J Psychiatry* 2001;178:145–53.
30. Jacobi F, Wittchen H-U, Holting C, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). *Psychol Med* 2004;34:597–611.
31. Bijl RV, Ravelli A, van Zessen G. Prevalence of psychiatric disorder in the general population: results of The Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Soc Psychiatry Psychiatr Epidemiol* 1998;33:587–95.
32. Kringlen E, Torgersen S, Cramer V. A Norwegian psychiatric epidemiological study. *Am J Psychiatry* 2001;158:1091–8.
33. Gonçalves DA, Mari JJ, Bower P, et al. Brazilian multicentre study of common mental disorders in primary care: rates and related social and demographic factors. *Cad Saude Publica* 2014;30:623–32.
34. Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. Results from the National Comorbidity Survey. *Arch Gen Psychiatry* 1994;51:8–19.
35. Batty GD, Deary IJ, Macintyre S. Childhood IQ in relation to risk factors for premature mortality in middle-aged persons: the Aberdeen Children of the 1950s study. *J Epidemiol Community Health* 2007;61:241–7.
36. Rodgers B. Models of stress, vulnerability and affective disorder. *J Affect Disord* 1991;21:1–13.
37. Hammen C. Stress and depression. *Annu Rev Clin Psychol* 2005;1:293–319.
38. Ameringer KJ, Leventhal AM. Associations between attention deficit hyperactivity disorder symptom domains and DSM-IV lifetime substance dependence. *Am J Addict* 2013;22:23–32.
39. Capusan AJ, Bendtsen P, Marteinsdottir I, et al. Comorbidity of Adult ADHD and Its Subtypes With Substance Use Disorder in a Large Population-Based Epidemiological Study. *J Atten Disord* 2016;27:108705471562651.
40. Williamson D, Johnston C. Gender differences in adults with attention-deficit/hyperactivity disorder: A narrative review. *Clin Psychol Rev* 2015;40:15–27.
41. Nohr EA, Olsen J. Commentary: Epidemiologists have debated representativeness for more than 40 years--has the time come to move on? *Int J Epidemiol* 2013;42:1016–7.
42. Rothman KJ, Gallacher JE, Hatch EE. Why representativeness should be avoided. *Int J Epidemiol* 2013;42:1012–4.
43. Ng JW, Kwan R, Cheok CC. Clinical and Functional Outcomes in Young Adult Males With ADHD. *J Atten Disord* 2017;21:465–74.
44. Sternat T, Katzman MA. Neurobiology of hedonic tone: the relationship between treatment-resistant depression, attention-deficit hyperactivity disorder, and substance abuse. *Neuropsychiatr Dis Treat* 2016;12:2149–64.
45. Ehsan AM, De Silva MJ. Social capital and common mental disorder: a systematic review. *J Epidemiol Community Health* 2015;69:1021–8.
46. Halmøy A, Fasmer OB, Gillberg C, et al. Occupational outcome in adult ADHD: impact of symptom profile, comorbid psychiatric problems, and treatment: a cross-sectional study of 414 clinically diagnosed adult ADHD patients. *J Atten Disord* 2009;13:175–87.
47. Statistics Norway. Employment, register-based. <https://www.ssb.no/statistikkbanken/selectarval/define.asp?SubjectCode=al&ProductId=al&MainTable=SysKjAldProsNY&contents=SysSelsatte&PLanguage=1&Qid=0&nvl=True&mt=1&pm=&SessID=14991528&FokusertBoks=1&gruppe1=Hele&gruppe2=Hele&gruppe3=Hele&gruppe4=Hele&VS1=Landet&VS2=Kjonn3&VS3=AlleAldre09dc&VS4=&CMSSubjectArea=arbeid-og-lonn&KortNavnWeb=regsys&StatVariant=&Tabstrip=SELECT&aggresetnr=1&checked=true>



Work participation in ADHD and associations with social characteristics, education, lifetime depression, and ADHD symptom severity

Espen Anker¹ · Anne Halmøy^{2,3} · Trond Heir⁴

Received: 1 April 2018 / Accepted: 20 July 2018
© The Author(s) 2018

Abstract

The literature refers to high rates of occupational failure in the population of adults with ADHD. The explanation for this is less known. The aim of the present study was to examine associations between social characteristics and clinical features of adults with ADHD and their occupational outcome. Out of 1050 patients diagnosed with ADHD in a specialized outpatient clinic between 2005 and 2017, 813 (77.4%) agreed to participate in the study. ADHD was diagnosed according to DSM-IV criteria, and ADHD subtypes recorded accordingly. Lifetime depression was diagnosed using the specific module of the Mini International Neuropsychiatric Interview. Occupational status and other social characteristics like marital status and living with children were recorded. Intelligence (IQ) and symptom severity of ADHD (ASRS score) were assessed in subsamples of participants ($n = 526$ and $n = 567$, respectively). In this sample of adults with ADHD (mean age 36.9 years, 48.5% women), 55.3% of the women and 63.7% of the men were working at the time of inclusion. Work participation was associated with being male, being married or cohabitant, or living with children, as well as a life story without major depression. Age, education, ADHD subtype, and ADHD symptom severity were not significantly associated with work participation. Neither was IQ when adjusted for other covariates. Occupational outcome in adults with ADHD appears to be more associated with social characteristics and a history of depression, rather than with IQ, ADHD subtype, or ADHD symptom severity.

Keywords ADHD · Occupational outcome · Gender · Social characteristics · Major depression · IQ · ASRS

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a life-span neuropsychiatric disorder with core symptoms of inattention, hyperactivity, and impulsivity (DSM-5 2013). The prevalence of ADHD in the adult population is reported to be 3–5% (Fayyad et al. 2007; Kessler et al. 2006). As stated by the definition of the disorder itself (DSM-IV 2004),

ADHD causes impairment and suffering in several domains of life (Kooij et al. 2010; Thomas et al. 2015). Of individual as well as socioeconomic interest are the adverse consequences for the ability to cope in working life. Longitudinal follow-up studies of children and cross-sectional studies of adults suggest that ADHD increases the risk of unemployment (Erskine et al. 2016; Halmøy et al. 2009; Gjervan et al. 2012; Sobanski et al. 2007) and that employees with ADHD perform poorly, change and quit jobs, and are dismissed more often than people without ADHD (Murphy and Barkley 1996).

Occupational failure may be due to ADHD-specific symptoms themselves, comorbid disorders, educational failure, or other social factors, of which some may be associated with ADHD. There is, however, insufficient knowledge about which factors that are most predictive of unemployment in ADHD patients of working age. For example, ADHD severity in terms of more symptoms of inattention has been shown to be associated with failure in work or education (Fredriksen et al. 2014). Also, a lifetime diagnosis of a comorbid

✉ Espen Anker
espen.anker@online.no

¹ Oslo ADHD Clinic, Kirkeveien 64B, 0366, Oslo, Norway

² Department of Psychiatry, Haukeland University Hospital, Bergen, Norway

³ K.G. Jebsen Centre for Research on Neuropsychiatric Disorders, Department of Biomedicine, University of Bergen, Bergen, Norway

⁴ Institute of clinical Medicine, University of Oslo, Oslo, Norway

psychiatric disorder has been shown to be associated with unemployment (Sobanski et al. 2007). A prospective study of children with ADHD showed that lower self-esteem was associated with lower educational achievement and subsequent lower occupational rank in adulthood (Slomkowski et al. 1995). Retrospectively, adults with ADHD more often report a history of inferior performance and disciplinary problems in their school years compared to controls (Murphy and Barkley 1996), and they have lower education (Ebejer et al. 2012; Küpper et al. 2012; Barkley et al. 2006). However, the relationship between educational level and occupational functioning is less consistent for people with ADHD than for the general population (Biederman et al. 2008). Several studies have related socioeconomic factors to childhood mental health in general and to ADHD in particular (Bøe et al. 2012; Russell et al. 2015), but we are not aware of studies that have investigated their relationship to work participation among individuals with ADHD in adult life.

To our knowledge, there is a lack of studies that include a comprehensive model of factors that may be associated with occupational outcome in individuals with ADHD. Thus, the aim of this study was to estimate the prevalence of work participation in patients with ADHD and to examine whether gender, age, and social characteristics, such as marital status, living with children, living in a city, or level of education, were associated with work participation. Also, we wanted to examine whether IQ, a history of lifetime major depression, ADHD subtype, or symptom severity of ADHD were associated with occupational outcome.

Methods

Participants

The study sample consisted of adult patients who fulfilled the criteria for Attention Deficit Hyperactivity Disorder (ADHD) according to the DSM-IV (2004). All were admitted to a private outpatient clinic in Oslo, Norway, that is specialized in psychiatric examinations, assessment, and treatment of ADHD. Recruitment was conducted in the years from 2005 to 2017. During these years, a total of 1050 patients were found to meet the diagnostic criteria of ADHD and asked to participate in the study. The patients were self-referred (54.5%) or referred by general physicians, specialists, or neuropsychologist (45.5%).

Out of 1050 patients with ADHD, 798 actively consented to participate in the study. Also included, with approval of the Regional Ethics Committee, were 15 patients who had died after the examination. In total, 813 patients were included (77.4%). The study was approved by the Regional Ethics Committee, southeast Norway. Assessments and

handling of data were carried out in accordance with ethical standards and the principles of the Declaration of Helsinki.

Measures

All patients had prior to the clinical psychiatric assessment either been to a neuropsychological examination or had been examined by a special educational teacher with experience and expertise in the use of WAIS-III (Kaufmann 1999) and ADHD. These examinations concluded with clinical evidence of concentration and attention difficulties, and/or cognitive profiles characteristic for ADHD, respectively.

A psychiatric examination was undertaken for all patients included in the study. The clinical diagnosis of ADHD required six out of nine symptoms of inattention or six out of nine symptoms of hyperactivity or impulsivity present for at least six months prior to assessment, causing impairment, according to the diagnostic manuals of DSM-IV (2004). The symptoms must cause significant impairment in social, academic, or occupational functioning. Furthermore, some hyperactive, impulsive, or inattentive symptoms must have been present before the age of seven years. Parents, teachers, or other relevant persons were interviewed about the patients' childhood, when possible, to confirm whether they met the criteria for ADHD in childhood. Patients with ADHD were categorized according to the classification criteria for predominantly inattentive subtype, predominantly hyperactive/impulsive subtype, or combined subtype (DSM-IV 2004).

Work participation was categorized as 'yes' if work was reported as the main source of income. Information about age, sex, marital status, whether the patient was living with children and living in or outside a city was recorded. Educational level was categorized by number of years in education: 12 years or less, 13-15 years, or more than 15 years. Lifetime depression was diagnosed using the specific module of the Mini International Neuropsychiatric Interview (M.I.N.I.), according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria (Sheehan et al. 1997, 1998).

IQ was measured in a subsample of 526 participants (64.7%), using the WAIS-III test (Kaufman 1999).

ADHD symptom severity was measured in a subsample of 567 (69.7%) participants, using the Adult ADHD Self-Report Scale (ASRS) Symptom Check List, v1.1 (WHO 2007). The ASRS is a reliable and valid screening instrument for evaluating ADHD in adults (Adler et al. 2006; Silverstein et al. 2017). This 18-item version yields a score ranging from 0 to 72 points.

Statistical analyses

We performed Chi-square tests or t-tests to compare sociodemographic characteristics between participants and non-participants, and between men and women. We used logistic regression analyses to examine associations between work participation as the dependent variable and social characteristics, level of education, lifetime depression, IQ, ADHD subtype, and ADHD symptom severity as independent variables. All tests were two-tailed, and differences were considered significant if $p < 0.05$. All statistical analyses were done using the software package SPSS version 22.

Results

Out of 1050 patients with ADHD, 813 (77.4%) participated in the study. Participants had a slightly higher educational level, and more of them were living with children, compared to non-participants. Otherwise, participants and non-participants were quite similar (data not shown).

Table 1 shows participants' gender, age, social characteristics, education, work participation, lifetime depression, and whether hyperactivity was part of the ADHD symptomatology. Altogether, 59.7% of the participants were working, more men than women. More women than men were living with children. Most participants (85.4%) had the combined subtype of ADHD (ADHD-C), and the remaining the predominantly inattentive subtype, as none of the included

Table 1 Description of 813 adult patients diagnosed with ADHD in a psychiatric clinic specialized in examination and treatment of ADHD. When others not specified, figures are given as numbers (percentage)

	Women 394	Men 419	All patients: 813
Age in years: mean (SD)	37.4 (10.9)	36.5 (11.4)	36.9 (11.2)
Age range (in years)	18–69	18–67	18–69
Married/cohabitant	166 (42.1)	181 (43.2)	347 (42.7)
Living with children	195 (49.5)***	155 (37.0)	350 (43.1)
Living in a city	230 (58.4)	259 (61.8)	489 (60.1)
Years of education: ≤ 12	208 (52.8)	232 (55.4)	440 (54.1)
13–15	150 (38.1)	152 (36.3)	302 (37.2)
> 15	36 (9.1)	35 (8.3)	71 (8.7)
Working	218 (55.3)*	267 (63.7)	485 (59.7)
Depression lifetime	135 (34.3)	132 (31.5)	267 (32.8)
Clinical subtypes of ADHD			
Combined	341 (86.5)	353 (84.2)	694 (85.4)
Predominantly inattentive	53 (13.5)	66 (15.8)	119 (14.6)
Predominantly hyperactive/impulsive	0	0	0

* $p < 0.05$, ** $p < 0.01$; *** $p < 0.001$ (woman compared with men)

Table 2 Odds ratios for work participation in a clinical sample of 813 adult patients with ADHD (logistic regression)

	Crude/unadjusted		Adjusted	
	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
Sex (female vs. male)	0.71 (0.53–0.93)	0.015	0.55 (0.40–0.75)	<0.001
Age (increase pr. 10 years)	1.21 (0.97–1.53)	0.098	1.15 (0.99–1.32)	0.067
Marriage/Cohabitant (yes vs. no)	2.98 (2.21–4.03)	<0.001	1.65 (1.16–2.36)	0.006
Living with children (yes vs. no)	4.20 (3.07–5.74)	<0.001	3.61 (2.49–5.23)	<0.001
Living in a city (yes vs. no)	0.96 (0.72–1.28)	0.802	1.32 (0.95–1.83)	0.096
Education: ≤ 12 years (ref)	–	–	–	–
13–15 years	1.47 (1.09–2.00)	0.011	1.33 (0.96–1.84)	0.091
> 15 years	2.28 (1.31–3.98)	0.004	2.10 (1.15–3.84)	0.016
Lifetime depression (yes vs. no)	0.60 (0.45–0.81)	0.001	0.62 (0.45–0.86)	0.004
Combined subtype of ADHD versus predominantly inattentive subtype ^a	1.13 (0.76–1.67)	0.55	1.12 (0.72–1.74)	0.61

^aNone of the included patients had the predominantly hyperactive/impulsive subtype of ADHD

patients was found to have the predominantly hyperactive/impulsive subtype.

Table 2 shows how sociodemographics and clinical features were related to occupational outcome. Work participation was associated with male gender, being married or cohabitant, living with children, level of education, and having a life story without episodes of major depression. Age, urban living, or ADHD subtype were not significantly associated with work participation.

In a subsample of 526 adult patients with IQ data, 322 (61.2%) were working, 145 women (58.0%) and 177 men (64.1%). Mean IQ was 101.3 for woman and 104.0 for men ($p=0.024$). IQ was significantly associated with work participation when unadjusted (OR, increase per ten IQ points: 1.16, 95% CI 1.02–1.31, $p=0.026$) but not when adjusted for other covariates (OR 1.04, 95% CI 0.89–1.23, $p=0.62$). IQ had no confounding effects in models of multiple logistic regression (data not shown). There were no significant differences between the subsamples with and without measures on IQ regarding gender, age, or any of the registered social characteristics.

In another subsample of 567 patients with data on ASRS, mean ASRS score was 52.4 (SD: 9.34) for women and 50.1 (SD: 9.33) for men ($p=0.003$). Symptom severity level of ADHD was not associated with work participation, neither unadjusted (OR 0.99, 95% CI 0.98–1.01, $p=0.39$) nor adjusted for other covariates (OR 0.99, 95% CI 0.97–1.02, $p=0.61$). Symptom severity level of ADHD had no confounding effects in models of multiple logistic regression (data not shown). There were no significant differences between the subsamples with and without data on ASRS regarding gender, age, or any of the social characteristics.

Discussion

In this study, we examined the prevalence and correlates of being in work in a clinical sample of adults with ADHD. Of the 813 included patients, 59.7% were working at the time of assessment. Work participation was associated with male gender, being married or cohabitant, living with children, higher levels of education, and having a life story without episodes of major depression. IQ was significantly associated with work participation in unadjusted analysis, but not when adjusted for other covariates. Age, ADHD subtype, or total ADHD symptom severity were not significantly associated with work participation.

The nearly 60% work participation in our study was higher than reported in other clinical samples of Norwegian adults with ADHD (Halmøy et al. 2009; Gjervan et al. 2012; Fredriksen et al. 2014). Higher working rates in our study may reflect that patients attending a private ADHD

clinic have higher social status and better finances than the average of patients referred to the public health service and that being in work can be both a cause and a consequence of socioeconomic differences. Higher working rates in our study may also reflect a time trend of increased awareness of ADHD in adults, which leads to more well-functioning patients receiving an ADHD diagnosis.

Nevertheless, work participation in our study was lower than the 70–80% working rates in the general Norwegian population reported by Statistics Norway (SSB 2016). This is in line with the nature and definition of the ADHD diagnosis itself, a disorder causing impairment in several domains of life (Kooij et al. 2010; Murphy and Barkley 1996). A higher working rate in men (63.7%) compared to women (59.7%) is in accordance with other studies of adult ADHD (Fredriksen et al. 2014; Halmøy et al. 2009) and may reflect gender differences in the general population (SSB 2016).

Correlates of work participation

Our findings indicate that social relationships such as being married or cohabiting, or living with children, can involve stability or support that may promote work participation. This is in line with previous findings that perceived support and positive attitude of family and social environment are important predictors of work outcome (Holwerda et al. 2013). Alternatively, being in work may increase income and social status and provide greater opportunities for a successful family life, or there may be some social or individual characteristics that facilitate both family and work participation. For example, adults with ADHD experience more family instability over time than adults without ADHD (Murphy and Barkley 1996; Jaber et al. 2015), suggesting that some ADHD-related features can lead to lower participation in both work and family life.

Unlike other studies of clinical ADHD populations (Ebejer et al. 2012; Küpper et al. 2012; Barkley et al. 2006), we found higher levels of education than in the general population (SSB 2016). Again, this may be due to the high socioeconomic status in patients attending a private ADHD clinic. The current evidence implies that ADHD gives an educational and vocational disadvantage through life (Mannuzza et al. 1993; Barkley et al. 2006). Accordingly, we found that education was related to work participation in the within-sample analyses, which confirms a relationship between education and work ability (Monteiro et al. 2006).

Some authors have suggested that educational attainment may represent a proxy for IQ because individuals with higher IQ stay longer within education (Batty et al. 2007). In our study, however, the relationship between education and work participation was independent of IQ, and IQ was poorly related to work participation when adjusted for other covariates. Although the assessment of IQ was limited to a

subsample, our findings indicate that there may be other factors than intelligence that are more important for educational attainment in people with ADHD and that level of intelligence is not essential for work participation. The findings that neither ADHD subtypes nor ADHD symptom severity was associated with work participation were quite surprising, considering evidence-based knowledge that ADHD provides lower work performance (Mannuzza et al. 1993; Shifrin et al. 2010; Brook et al. 2013). Fulfilling education and getting or keeping a job may be affected by the symptoms of ADHD, due to lack of concentration or disturbance by hyperactivity and impulsivity (Barkley et al. 2006; Fredriksen et al. 2014). ADHD is a dimensional diagnosis, ranging from mild to severe (Swanson et al. 2012), which makes it likely to imagine a dose–response relationship between symptom severity and work ability. However, it is possible that having ADHD or not is of greater importance to whether people are working than are the differences in symptom severity within a clinical ADHD population.

Methodological considerations

The study has some methodological issues that should be noted. First, the cross-sectional design limits the interpretation of causal relationships. Second, patients attended to a private ADHD clinic may not be representative for people with ADHD in general. For example, our participants had higher rates of work participation than other clinical samples of Norwegian adults with ADHD (Halmøy et al. 2009; Gjervan et al. 2012; Fredriksen et al. 2014). However, we believe that differences in the sample selection may primarily affect the frequency estimates of work participation and its correlates and to a lesser extent family and social relationships (Nohr and Olsen 2013; Rothman et al. 2013). Third, we restricted our examination of lifetime comorbid disorders to major depression. The clinical interview M.I.N.I. is limited to retrospective information about four disorders during lifetime: major depression, bipolar disorder, panic disorder, and psychosis. We chose to use data on lifetime depression since depression is by far the most common of these disorders in our adult ADHD population (Anker et al. 2018; Solberg et al. 2018). Nevertheless, we lack information about other common disorders in the past, such as social phobia and substance use disorders.

Strengths of the study include a naturalistic design and inclusion of patients that were admitted to examination or treatment of adult ADHD. The number of participants and rate of consent were high, and patients were recruited from a large area and over a longer period of time. There were no exclusion criteria; anyone who met the ADHD criteria was asked to participate in the study.

Implications

Work increases status, social power, and economic independence (Ross and Mirowsky 1995) and is an important aspect of mental health (WHO 2012). An overall goal should be to help people with ADHD to get jobs and continue to work. A key question is whether treatment targeting primarily symptom reduction of ADHD in adults can facilitate work performance (Kessler et al. 2005). The lack of correlation between total ADHD severity score and work participation in our study does not indicate this, despite that successful treatment of adult ADHD is known to be associated with substantial gains in cognition and behavior (Schweitzer et al. 2004; Turner et al. 2004).

However, ADHD may have causal effects on work participation that are mediated by more proximate causes such as social skills, education, or comorbid mental disorders. Such correlates, although they most likely have been affected by ADHD, were stronger associated with work participation than the total ADHD symptom severity or the clinical subtypes of ADHD. These observations call for appropriate follow-up and treatment of ADHD from childhood through adolescence and adulthood in order to facilitate education, social affiliation, and prevention of comorbid psychiatric disorders. Interventions focusing on positive resources may be even as important as symptom reduction in itself.

The prevalence of life time depression in our sample was well above what is expected in the general population (Kessler et al. 1994), and comorbid depression seems to be an important target of prevention and intervention. It is worth mentioning in this regard that adults who have been more extensively treated for their ADHD have been proven to be more resilient to depression (Oddo et al. 2018).

Acknowledgements We especially want to thank Christina Bjercke for performing 526 WAIS tests.

Authors contributions EA and TH designed the study. EA collected and analyzed the data. EA, AH, and TH participated actively in the writing of the manuscript and approved the final draft.

Funding This work was supported by the Norwegian Medical Association and Stiftelsen K.G. Jebsen.

Compliance with ethical standards

Conflict of interest The authors report no conflicts of interest.

Data availability statement Data are from a private psychiatric outward in Oslo. Public availability would compromise privacy of the respondents. According to the approval from the Norwegian Regional Committees for Medical and Health Research Ethics, the data are to be stored properly and in line with the Norwegian Law of Privacy Protection. However, anonymized data are freely available to interested researchers upon request, pending ethical approval from our ethics committee.

Interested researchers can contact project leader Espen Anker (espen.anker@online.no) with requests for the data underlying our findings.

Ethics approval Regional Committees for Medical Research Ethics—South East Norway—REC—approved this study.

Patient consent Patient consent was obtained.

Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

References

- Adler LA, Spencer T, Faraone SV, Kessler RC, Howes MJ, Biederman J (2006) Validity of pilot adult ADHD self-report scale (ASRS) to rate adult ADHD symptoms. *Ann Clin Psychiatry* 18(3):145–148
- American Psychiatric Association (2004) Diagnostic and statistical manual of mental disorders, fourth edition, text revision. American Psychiatric Association, Washington, DC
- American Psychiatric Association (2013) The diagnostic and statistical manual of mental disorders, fifth edition (DSM-5). American Psychiatric Association, Washington, DC
- Anker E, Bendiksen B, Heir T (2018) Comorbid psychiatric disorders in a clinical sample of adults with ADHD, and associations with education, work and social characteristics: a cross-sectional study. *BMJ Open* 8:e019700. <https://doi.org/10.1136/bmjopen-2017-019700>
- Barkley RA, Fischer M, Smallish L, Fletcher MAK (2006) Young adult outcome of hyperactive children: adaptive functioning in major life activities. *J Am Acad Child Adolesc Psychiatry* 45(2):192–202
- Batty GD, Deary IJ, Macintyre S (2007) Childhood IQ in relation to risk factors for premature mortality in middle-aged persons: the Aberdeen Children of the 1950s study. *J Epidemiol Comm Health* 61:241–247
- Biederman J, Ball SW, Monuteaux MC, Mick E, Spencer TJ, McCreary M, Cote M, Faraone SV (2008) New insights into the comorbidity between ADHD and major depression in adolescent and young adult females. *J Am Acad Child Adolesc Psychiatry* 47(4):426–434
- Bøe T, Øverland S, Lundervold AJ, Hysing M (2012) Socioeconomic status and children's mental health: results from the Bergen Child Study. *Soc Psychiatry Psychiatry Epidemiol* 47(10):1557–1566. <https://doi.org/10.1007/s00127-011-0462-9> (Epub 2011 Dec 20)
- Brook JS, Brook DW, Zhang C, Seltzer N, Finch SJ (2013) Adolescent ADHD and adult physical and mental health, work performance, and financial stress. *Pediatrics* 131(1):5–13
- Ebejer JL, Medland SE, van der Werf J, Gondro C, Henders AK, Lynskey M, Martin NG, Duffy DL (2012) Attention deficit hyperactivity disorder in Australian adults: prevalence, persistence, conduct problems and disadvantage. *PLoS ONE* 7(10):47404
- Erskine E, Norman RE, Ferrari AJ, Chan GCK, Copeland WE, Whitford HA, Scott JG (2016) Long-term outcomes of attention-deficit/hyperactivity disorder and conduct disorder: a systematic review and meta-analysis holly. *J Am Acad Child Adolesc Psychiatry* 55(10):840–850
- Fayyad J, De Graaf R, Kessler R, Alonso J, Angermeyer M, Demeytenaere K, De Girolamo G, Haro JM, Karam EG, Lara C, Lépine JP, Ormel J, Posada-Villa J, Zaslavsky AM, Jin R (2007) Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *Br J Psychiatry* 190:402–409
- Fredriksen M, Dahl AA, Martinsen EW, Klungsoyr O, Haavik J, Peleikis DE (2014) Effectiveness of one-year pharmacological treatment of adult attention-deficit/hyperactivity disorder (ADHD): an open-label prospective study of time in treatment, dose, side-effects and comorbidity. *Eur Neuropsychopharmacol* 24(12):1873–1884. <https://doi.org/10.1016/j.euronuro.2014.09.013> (Epub 2014 Oct 18)
- Gjervan B, Torgersen T, Nordahl HM, Rasmussen K (2012) Functional impairment and occupational outcome in adults with ADHD. *J Attent Disord* 16(7):544–552
- Halmøy A, Fasmer OB, Gillberg C, Haavik J (2009) Occupational outcome in adult ADHD: impact of symptom profile, comorbid psychiatric problems, and treatment—a cross-sectional study of 414 clinically diagnosed adult ADHD patients. *J Attent Disord* 13(2):175–187
- Holwerda A, van der Klink JLL, de Boer MR, Groothoff JW, Brouwer S (2013) Predictors of sustainable work participation of young adults with developmental disorders. *Res Dev Disabil* 34:2753–2763
- Jaber L, Kirsh D, Diamond G, Shuper A (2015) Long-term functional outcomes in Israeli adults diagnosed in childhood with attention deficit hyperactivity disorder. *Isr Med Assoc J* 17(8):481–485
- Kaufmann AS (1999) The essentials of WAIS-III assessment. Essentials of psychological assessment Series
- Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, Wittchen H-U, Kendler KS (1994) Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey. *Arch Gen Psychiatry* 51:8–19
- Kessler RC et al (2005) The prevalence and effects of adult attention deficit/hyperactivity disorder on work performance in a nationally representative sample of workers. *J Occup Environ Med* 47(6):565–572
- Kessler RC, Adler L, Barkley R, Biederman J et al (2006) The prevalence and correlates of adult ADHD in the United States. *Am J Psychiatry* 163(4):716
- Kooij SJJ et al (2010) European consensus statement on diagnosis and treatment of adult ADHD: the European network adult ADHD. *BMC Psychiatry* 10:67
- Küpper T, Haavik J, Drexler H, Ramos-Quiroga JA, Wermelskirchen D, Prutz C, Schauble B (2012) The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. *Int Arch Occup Environ Health* 85(8):837–847
- Mannuzza S, Klein RG, Bessler A, Malloy P, LaPadula M (1993) Adult outcome of hyperactive boys educational achievement, occupational rank, and psychiatric status. *Arch Gen Psychiatry* 50:565–576
- Monteiro MS, Ilmarinen J, Corraa Filho HR (2006) Work ability of workers in different age groups in a public health institution in Brazil. *Int J Occup Saf Ergon* 12(4):417–427
- Murphy K, Barkley R (1996) Attention deficit hyperactivity disorder adults: comorbidities and adaptive impairments. *Compr Psychiatry* 37(6):393–401
- Nohr EA, Olsen J (2013) Commentary: epidemiologists have debated representativeness for more than 40 years—has the time come to move on? *Int J Epidemiol* 42(4):1016–1017
- Oddo LE, Knouse LE, Surman CBH, Safren SA (2018) Investigating resilience to depression in adults with ADHD. *J Attent Disord* 22(5):497–505. <https://doi.org/10.1177/1087054716636937>
- Ross CE, Mirowsky J (1995) Does employment affect health? *J Health Soc Behav* 36:230–243
- Rothman KJ, Gallacher JEJ, Hatch EE (2013) Why representativeness should be avoided. *Int J Epidemiol* 42:1012–1014

- Russell AE, Ford T, Russell G (2015) Socioeconomic associations with ADHD: findings from a mediation analysis. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0128248>
- Schweitzer JB, Lee DO, Hanford RB, Zink CF, Ely TD, Tagamets MA, Hoffman JM, Grafton ST, Clinton D (2004) Kilt's effect of methylphenidate on executive functioning in adults with attention-deficit/hyperactivity disorder: normalization of behavior but not related brain activity. *Biol Psychiatry* 56:597–606. <https://doi.org/10.1016/j.biopsych.2004.07.011>
- Sheehan DV, Lecrubier Y, Sheehan KH et al (1997) The validity of the Mini International Neuropsychiatric Interview (M.I.N.I.) according to the SCID-P and its reliability. *Eur Psychiatry* 12:232–241
- Sheehan DV, Lecrubier Y, Sheehan KH et al (1998) The Mini-International Neuropsychiatric Interview (MINI) the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry* 59(20):22–33
- Shiffrin JG, Proctor BE, Prevatt FF (2010) Work performance differences between college students with and without ADHD. *J Att Dis* 13(5):489–496
- Silverstein MJ, Faraone SF, Alperin S, Biederman J, Spenscer TJ, Adler LA (2017) How informative are self-reported adult attention-deficit/hyperactivity disorder symptoms? An examination of the agreement between the adult attention-deficit/hyperactivity disorder self-report scale V1.1 and adult attention deficit/hyperactivity disorder investigator symptom rating scale. *J Child Adolesc Psychopharmacol*. <https://doi.org/10.1089/cap.2017.0082>
- Slomkowski C, Klein RG, Mannuzza S (1995) Is self-esteem an important outcome in hyperactive children? *J Abnormal Child Psychol* 23(3):303–315
- Sobanski E, Brüggermann D, Alm B, Kern S, Deschner M, Schubert T, Philipsen A, Reitschel M (2007) Psychiatric comorbidity and functional impairment in a clinically referred sample of adults with attention-deficit/hyperactivity disorder (ADHD). *Eur Arch Psychiatry Clin Neurosci* 257(7):371–377. <https://doi.org/10.1007/s00406-007-0712-8>
- Solberg BS, Halmøy A, Engeland A, Igeland J, Haavik J, Klungsoyr K (2018) Gender differences in psychiatric comorbidity: a population-based study of 40,000 adults with attention deficit hyperactivity disorder. *Acta Psychiatr Scand* 137:176–186
- Statistics Norway (2016) <http://www.ssb.no/294421/employed-persons-by-full-time-part-time-and-sex.2016.1-000-per-cent-and-average-contractual-usual-hours-per-week-sy-207>. Accessed 20 Jan 2018
- Swanson JM, Schuck S, Porter MM, Carlson C, Hartman CA, Sergeant JA, Clevenger W, Wasdell M, McCleary R, Timothy W (2012) Categorical and dimensional definitions and evaluations of symptoms of ADHD: history of the SNAP and the SWAN rating scales. *Int J Educ Psychol Assess* 10(1):51–70
- Thomas R, Sanders S, Doust J, Beller E, Glasziou P (2015) Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 135(4):e994–e1001. <https://doi.org/10.1542/peds.2014-3482> (Epub 2015 Mar 2)
- Turner DC, Clark L, Dowson J, Robbins TW, Sahakian BJ (2004) Modafinil improves cognition and response inhibition in adult attention-deficit/hyperactivity disorder. *Biol Psychiatry* 55(10):1031–1040. <https://doi.org/10.1016/j.biopsych.2004.02.008>
- World Health Organization (2007) Adult ADHD Self-Report Scale-V1.1 (ASRS-V1.1) Symptoms Checklist from WHO Composite International Diagnostic Interview
- World Health Organization (2012) Risks to mental health: an overview of vulnerabilities and risk factors background paper by who secretariat for the development of a comprehensive mental health action plan 27 August 2012 This WHO Discussion Paper does not represent an official position of WHO (please refer to the disclaimer included on the last page of this paper)



Observational Study

Alcohol and drug use disorders in adult attention-deficit/hyperactivity disorder: Prevalence and associations with attention-deficit/hyperactivity disorder symptom severity and emotional dysregulation

Espen Anker, Jan Haavik, Trond Heir

ORCID number: Espen Anker 0000-0003-4960-1715; Jan Haavik 0000-0001-7865-2808; Trond Heir 0000-0001-9616-0145.

Author contributions: Anker E and Heir T designed the study; Anker E collected and analyzed the data; Anker E, Haavik J, and Heir T actively participated in the writing of the manuscript; all authors approved the final draft.

Supported by NevSom University of Oslo, No. 51379.

Institutional review board statement: The study was reviewed and approved by (Regionale Komiteer for Medisinsk og Helsefaglig Forskningsetikk). Norwegian Regional committees for medical and health research ethics.

Informed consent statement: All study participants gave written informed consent to participate in the study.

Conflict-of-interest statement: Espen Anker has received speaker honoraria from Shire; Jan Haavik has received speaker honoraria from Lilly, Shire, HB Pharma,

Espen Anker, Oslo ADHD clinic, Oslo 0366, Norway

Jan Haavik, Department of Biomedicine, University of Bergen, Bergen 5007, Norway

Jan Haavik, Division of Psychiatry, Haukeland University Hospital, Bergen 5021, Norway

Trond Heir, Institute of Clinical Medicine, University of Oslo, Oslo 0316, Norway

Corresponding author: Espen Anker, MD, Oslo ADHD Clinic, Kirkeveien 64B, Oslo 0366, Norway. espen.anker@online.no

Abstract

BACKGROUND

High risk of alcohol and drug use disorders in people with attention-deficit/hyperactivity disorder (ADHD) calls for exploratory research of relationships with clinical features of ADHD.

AIM

To estimate prevalence of alcohol/drug use disorders and associations with ADHD symptom severity and emotional dysregulation, in adults with ADHD.

METHODS

This observational cross-sectional clinical study consisted of patients admitted to a private psychiatric outpatient clinic in Oslo, Norway (2014-2018). Five-hundred and fifty-eight eligible patients diagnosed with ADHD (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria) agreed to participate. Alcohol and drug use disorders were diagnosed using the Mini International Neuropsychiatric Interview (MINI). Dependence and abuse were merged into "use" disorder as in MINI version 7.0/DSM-5. Questions were related both to lifetime and the past 12-mo. ADHD severity was assessed by the Adult ADHD Self Report Scale (ASRS). Subdivisions of the ASRS questionnaire as inattentive items and hyperactive/impulsivity items were recorded separately. Emotional dysregulation was assessed by the eight-item version of Barkley's Current Behavior Scale - Self Report.

Medice and Biocodex; Trond Heir reports having no competing interests.

Data sharing statement: Data are from a private psychiatric outward in Oslo. Public availability would compromise privacy of the respondents. According to the approval from the Norwegian Regional committees for medical and health research ethics, the data is to be stored properly and in line with the Norwegian Law of privacy protection. However, anonymized data is freely available to interested researchers upon request, pending ethical approval from the ethics committee. Interested researchers can contact project leader Espen Anker (espen.anker@online.no) with requests for the data.

STROBE statement: The authors have read the STROBE Statement – checklist of items, and the manuscript was prepared and revised according to the STROBE Statement – checklist of items.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Manuscript source: Unsolicited manuscript

Received: June 3, 2020

Peer-review started: June 3, 2020

First decision: June 20, 2020

Revised: July 11, 2020

Accepted: August 15, 2020

Article in press: August 15, 2020

Published online: September 19, 2020

P-Reviewer: Bertocci M

RESULTS

The 12-mo prevalence was 5.3% for alcohol use disorder and 13.7% for drug use disorder. The lifetime prevalence was 12.0% for alcohol use disorder and 27.7% for drug use disorder. Men had higher rates of both alcohol use disorder and drug use disorder compared to women. The prevalence of drug use disorder was more than twice that of alcohol use disorder for both sexes. The drugs most participants reported having used were (in descending order): Amphetamine (19.1%), cannabis (17.1%), cocaine or ecstasy (7.4%), benzodiazepines (7.4%), and heroin or other opioids (2.9%). Lifetime drug use disorder was significantly associated with both hyperactivity-impulsivity symptoms and emotional dysregulation symptom severity. Lifetime alcohol use disorder, on the other hand, was not significantly associated with ADHD symptoms or emotional dysregulation when adjusted for gender and age.

CONCLUSION

Patients with ADHD have a high lifetime prevalence of drug use disorder, which is associated with higher levels of hyperactivity-impulsivity symptoms and emotional dysregulation.

Key words: Attention-deficit/hyperactivity disorder; Adult ADHD Self Report Scale; Emotional dysregulation; Substance use disorder; Alcohol use disorder; Drug use disorder

©The Author(s) 2020. Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: High rates of alcohol and drug use disorders in people with attention-deficit/hyperactivity disorder (ADHD) needs further explanation. In this study of adult ADHD patients in clinical practice, we found a remarkably high incidence of past or current drug use disorder, especially for amphetamine and cannabis. Drug use disorder but not alcohol was associated with clinical features of ADHD, such as hyperactivity-impulsivity symptoms and emotional dysregulation. The findings point to self-medication for ADHD as a plausible explanation and suggest early diagnosis and treatment of ADHD as a preventive strategy against substance abuse.

Citation: Anker E, Haavik J, Heir T. Alcohol and drug use disorders in adult attention-deficit/hyperactivity disorder: Prevalence and associations with attention-deficit/hyperactivity disorder symptom severity and emotional dysregulation. *World J Psychiatr* 2020; 10(9): 0-0

URL: <https://www.wjgnet.com/2220-3206/full/v10/i9/0.htm>

DOI: <https://dx.doi.org/10.5498/wjp.v10.i9.0000>

INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is a life-span neuropsychiatric disorder, with core symptoms of inattention, hyperactivity, and impulsivity^[1]. ADHD is caused by a multitude of additive and interactive genetic and environmental factors operating in a complex manner^[2-4]. The prevalence of ADHD in the general adult population is estimated to be 3%-5%^[5,6]. Furthermore, ADHD is a dimensional diagnosis in which attention deficits and hyperactivity-impulsivity may appear in various degrees and combinations^[7].

The co-occurrence of ADHD and substance use disorder (SUD), such as alcohol use disorder (AUD) or drug use disorder (DUD), has been studied in a variety of clinical and research settings. Overall, there is an earlier onset and elevated risk of SUD in people with ADHD^[6,8-16], but the direction of causality, underlying mechanisms, and clinical implications of the strong association between ADHD and SUD are still unclear.

It is well documented that many patients with ADHD strive to regulate negative emotions^[17-19]. They may be quick to anger, easily frustrated, and emotionally over-excitable, a symptom cluster defined as emotional dysregulation (ED)^[20-22]. Although ED may be understood as a transdiagnostic factor^[23], in the development of psychopathology^[24] it appears to be specifically related to impulsivity^[25]. ED is associated with SUD in children and adolescents^[26] as well as in adults with ADHD^[27].

S-Editor: Liu JH

L-Editor: A

P-Editor: Li JH



The strong relationship between ADHD and ED^[17-19] makes it challenging to determine which of them is mainly related to SUD.

The aim of the present study was to estimate the prevalence of AUD and DUD in a clinical sample of adults with ADHD, and to examine the association with ADHD symptom severity and ED.

MATERIALS AND METHODS

This was an observational cross-sectional clinical study.

Participants

The study sample consisted of adult patients, age ranging from 18 to 69, who fulfilled the criteria for ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (commonly referred to as the DSM-5)^[1]. They were admitted to a private psychiatric clinic in Oslo, Norway, which specialized in psychiatric examinations and treatment of ADHD.

Recruitment was conducted between 2014 and 2018. ADHD was assessed using DIVA 2.0, the semi-structured Diagnostic Interview for Adult ADHD, second edition^[28], which was performed by a psychiatrist for all patients included in the study. A clinical diagnosis of ADHD was established according to DSM-5^[1]. During these years, 656 of the assessed patients fulfilled the diagnostic criteria of ADHD and were invited to participate in the study, of whom 65% were self-referred and 35% were referred by healthcare practitioners. None of the participants were using prescribed stimulant medication prior to study inclusion.

Of the 656 patients (351 men and 305 women) with ADHD, 585 (89.2%) gave written informed consent to participate in the study. There were no exclusion criteria. The study was approved by the Regional Medical Ethics Committee, South-East Norway, 2015/426. Assessments were carried out in accordance with ethical standards and the principals of the Declaration of Helsinki.

Measures

The age of the participants was recorded as their numbers of lived-years when entering the study. Gender was recorded as women (scored as 0) and men (scored as 1) from the information revealed by the participant. Sociodemographic information included: If the participant was married or cohabiting, scored as 1, and if not, scored as 0; If the participant was living with children, inclusive partial custody, scored as 1, and if not (even though having children somewhere else), scored as 0; Educational level, categorized by the number of years in education, with 12 years or less scored as 1, 13-15 years scored as 2, or more than 15 years scored as 3; and, work participation, which was defined as “yes” and scored as 1, if work was reported as the main source of income, and if not was scored as 0.

AUD and DUD were diagnosed using the specific module of the Mini International Neuropsychiatric Interview (MINI), Norwegian Translation Version 6.0.0, according to DSM-IV criteria^[29,30]. Dependence and abuse were merged into “use” disorder, as in MINI version 7.0/DSM-5, and questions were both restricted to the last 12-mo and related to lifetime prevalence. The presence of AUD was scored as 1, and absence as 0. The presence of DUD was scored as 1, and the absence as 0. ADHD symptom severity was measured using the Adult ADHD Self Report Scale (ASRS) Symptom Check List, v1.1 by the World Health Organization 2007. The ASRS is a reliable and valid screening instrument for evaluating ADHD in adults^[31]. This 18-item version yields a score ranging from 0 to 72 points. We recorded subdivisions of the ASRS questionnaire, as inattentive items (item 1-4 and 7-11) and hyperactive/impulsivity items (item 5, 6, and 12-18) separately^[32].

ED was assessed by questionnaire with 8 items from the 99-item Current Behavior Scale - Self Report questionnaire^[33-35]. The 8 items were: 1: Quick to get angry or become upset; 2: Easily frustrated; 3: Overreact emotionally; 4: Easily excited by activities going on around me; 5: Lose my temper; 6: Argue with others; 7: Am touchy or easily annoyed by others; and 8: Am angry or resentful. The items were scored as never or rarely (0), sometimes (1), often (2), or very often (3). This yielded a total ED score ranging from 0 to 24.

Procedure

The data were collected during routine assessment in an outpatient clinic. Afterwards, the patients were asked if they approved the use of their clinical information in an

anonymous form as statistic material for this clinical trial. They gave their written informed consent to participate in the study after the examination.

Statistical analysis

We performed χ^2 tests or *t*-tests to compare sociodemographic characteristics between women and men. We used logistic regression analyses to examine associations between AUDs and DUDs as dependent variables and ADHD symptom severity and ED as independent variables. All tests were two-tailed. Because of our two hypotheses, we used multiple test correction according to Bonferroni, considering differences significant if $P < 0.025$. There were no missing data. All statistical analyses were carried out using the software package IBM 2016 SPSS version 22^[36].

RESULTS

Prevalence rates

Table 1 shows the sociodemographic and clinical characteristics of the men ($n = 317$) and women ($n = 268$) in the study. More women than men were living with children and women reported higher levels of ADHD symptoms and ED compared to men. **Table 2** shows the 12-mo prevalence and lifetime prevalence of AUD and DUD in men and women. Men had a significantly higher prevalence of both AUD and DUD compared to women. The prevalence of DUD was more than twice the prevalence of AUD for both sexes.

Prevalence of different drugs

In the total sample, 162 (27.7%) of the participants had a history of lifetime DUD related to amphetamine ($n = 112$, 69.1%), cannabis ($n = 100$, 61.7%), cocaine or ecstasy ($n = 43$, 26.5%), benzodiazepines ($n = 43$, 26.5%), heroin or other opioids ($n = 17$, 10.5%), and unspecified drugs ($n = 26$, 16.0%).

Associations with ADHD symptoms and ED

Tables 3 and 4 show associations between lifetime SUD and clinical characteristics, including hyperactivity-impulsivity and ED. Lifetime AUD was not significantly associated with the levels of ADHD symptoms or ED when adjusted for gender and age (Table 3). Lifetime DUD, on the other hand, was significantly associated with both hyperactivity-impulsivity and ED (Table 4).

DISCUSSION

In our clinical sample of adults with ADHD, we observed a 12-mo prevalence of 5.3% for AUD and 13.7% for DUD. The lifetime prevalence was 12.0% for AUD and 27.7% for DUD. All prevalence rates were higher for men than for women.

The 12-mo prevalence of AUD was similar to the general population prevalence reported in Norway and the United States^[37-39]. In contrast, the 12-mo prevalence of DUD was considerably higher than the United States (3.9%)^[40] and European (3.0%) estimated prevalences of DUD in the general population^[38]. A similar pattern was found for lifetime prevalence of AUD and DUD. While the lifetime prevalence of AUD in our study was lower than that in the general Norwegian or United States population^[37-39], the lifetime prevalence of DUD was considerably higher than what has been found in the Norwegian population^[41,42].

Our findings demonstrate the need to distinguish between different types of SUD to understand comorbidity in patients with ADHD. The finding that DUD, in contrast to AUD, was far more prevalent than in the general population, as well as our findings that DUD but not AUD was associated with increased ED and ADHD symptom severity, questions previous statements that ADHD is strongly associated with SUD in general^[13,14] or that the ADHD symptom severity is associated with increased risk for all kinds of SUD outcomes^[16]. According to our findings, there appears to be a significant difference between the risk of AUD and DUD in people with ADHD, at least in this Norwegian patient population.

Several factors can help explain this. First, genome-wide association studies have shown strong genetic correlations between ADHD and DUD^[43,44], while some genetic factors contributing to the risk of developing AUD are negatively correlated with ADHD^[45]. Second, there may be some shared environmental determinants for ADHD

Table 1 Demographic characteristics, attention-deficit hyperactivity disorder symptom severity, and emotional dysregulation in 585 adult patients diagnosed with attention-deficit hyperactivity disorder in a psychiatric clinic specialized in examination and treatment of attention-deficit hyperactivity disorder

	Men, n = 317	Women, n = 268	All patients, n = 585
Age in years, mean ± SD	36.2 (11.5)	37.5 (11.2)	36.8 (11.4)
Range	18-67	18-69	18-69
Married or cohabitant	143 (45.1)	107 (39.9)	250 (42.7)
Living with children	110 (34.7)	117 (43.7) ^a	227 (38.8)
Years of education: ≤ 12	172 (54.3)	129 (48.1)	301 (51.5)
13-15	121 (38.2)	108 (40.3)	229 (39.1)
> 15	24 (7.6)	31 (11.6)	55 (9.4)
Work participation	193 (60.9)	149 (55.6)	342 (58.5)
ADHD symptom severity ¹ , mean ± SD	50.4 (9.5)	52.3 (9.5) ^b	51.4 (9.5)
Inattention, mean ± SD	27.0 (4.6)	27.8 (4.9) ^a	27.4 (4.7)
Impulsivity-hyperactivity, mean ± SD	23.3 (6.6)	24.7 (6.5) ^b	24.0 (6.6)
Emotional dysregulation ² , mean ± SD	11.0 (5.6)	13.4 (5.3) ^c	12.1 (5.6)

When others not specified, figures are given as numbers (percentage).

^a $P < 0.05$.

^b $P < 0.01$.

^c $P < 0.001$; women compared with men.

¹Attention-deficit hyperactivity disorder (ADHD) symptom severity was assessed by the Adult ADHD Self Report Scale.

²Emotional dysregulation was assessed by 8 items from the Current Behavior Scale - Self Report questionnaire. SD: Standard deviation.

Table 2 Prevalences of alcohol or drug use disorders in 585 adult patients diagnosed with attention-deficit hyperactivity disorder in a psychiatric clinic specialized in examination and treatment of attention-deficit hyperactivity disorder

	Men, n = 317	Women, n = 268	All patients, n = 585
AUD			
- 12-mo	24 (7.6)	7 (2.6) ^b	31 (5.3)
- lifetime	47 (14.8)	23 (8.6) ^a	70 (12.0)
DUD			
- 12-mo	55 (17.4)	25 (9.1) ^b	80 (13.7)
- lifetime	103 (32.5)	59 (22.0) ^b	162 (27.7)
AUD or DUD			
- 12-mo	67 (21.1)	29 (10.8) ^b	96 (16.4)
- lifetime	114 (36.0)	65 (24.3) ^b	179 (30.6)

^a $P < 0.05$.

^b $P < 0.01$; women compared with men (χ^2). Figures are given in numbers (percentage). AUS: Alcohol use disorder; DUD: Drug use disorder.

and DUD^[44] – for example, maternal DUD^[46]. Third, drug dependence, especially the misuse of amphetamine and cannabis, has been suggested to be a result of self-medication related to ADHD symptoms^[47-49], which corresponds to the fact that amphetamine and cannabis were the preferred drugs for abuse in our study.

The higher prevalence rates of AUD and DUD in men compared to women are in accordance with gender differences in the general population^[37-40]. In line with others, we found that women reported higher levels of hyperactivity-impulsivity^[50] and ED^[51] compared with men.

Our observation that DUD was associated with higher ED is consistent with findings that ED in general increases the risk of developing and maintaining drug

Table 3 Associations between age, gender, attention-deficit hyperactivity disorder relevant clinical characteristics, and outcome of lifetime alcohol use disorder in a clinical sample of 585 adult attention-deficit hyperactivity disorder patients, non-adjusted and adjusted analysis

	Non-adjusted			Adjusted		
	OR	95%CI	P value	OR	95%CI	P value
Age, increasing in 10 yr	1.32	1.06-1.64	0.013	1.32	1.05-1.64	0.016
Gender, men <i>vs</i> women	1.94	1.14-3.31	0.015	2.19	1.27-3.77	0.005
Inattentive	1.03	0.98-1.09	0.27	1.01	0.95-1.07	0.82
Hyperactivity- impulsivity	1.05	1.01-1.09	0.027	1.03	0.98-1.08	0.24
Emotional dysregulation	1.05	1.00-1.09	0.06	1.04	0.98-1.10	0.16

CI: Confidence interval; OR: Odds ratio.

Table 4 Associations between age, gender, attention-deficit hyperactivity disorder relevant clinical characteristics, and outcome of lifetime drug use disorder in a clinical sample of 585 adult attention-deficit hyperactivity disorder patients, non-adjusted and adjusted analysis

	Non-adjusted			Adjusted		
	OR	95%CI	P value	OR	95%CI	P value
Age, increasing in 10 yr	1.10	0.94-1.29	0.24	1.08	0.92-1.27	0.36
Gender, men <i>vs</i> women	1.71	1.18-2.49	0.005	2.01	1.36-2.97	< 0.001
Inattentive	1.02	0.97-1.05	0.77	0.97	0.93-1.02	0.21
Hyperactivity-impulsivity	1.04	1.02-1.07	0.003	1.04	1.01-1.08	0.021
Emotional dysregulation	1.05	1.01-1.08	0.006	1.05	1.01-1.09	0.019

CI: Confidence interval; OR: Odds ratio.

addiction^[52]. DUD typically appears later in life than ADHD and ED, suggesting that DUD is modified by ADHD and ED, rather than *vice versa*. Nevertheless, it is possible that DUD may reinforce the symptoms of both ADHD and ED.

Methodological considerations

Patients attending a private and not governmental-funded ADHD clinic may not be representative for patients with ADHD in general. They may have a higher socio-economic status and be less impaired compared to those in public outpatient clinics or hospitals. Also, the prevalence of morbidity may not be representative of the total ADHD patient population. Still, the reported comorbidity prevalence rates in our study were similar to recently reported prevalences for the total Norwegian population^[72]. Finally, the cross-sectional design places strong limitations on interpretations of causal relationships.

CONCLUSION

In conclusion, in this study of adult ADHD patients, we found a much higher prevalence of DUD than what has been reported in general populations. DUD was independently associated with both higher symptom levels of hyperactivity-impulsivity and ED. Thus, a co-morbid DUD should be considered in adult ADHD patients, particularly in males and among individuals with high levels of hyperactive-impulsive ADHD core symptoms or ED. The causal mechanisms of the relationship between ADHD and DUD are not known, but self-medication for hyperactivity-impulsivity and ED is one possibility. Thus, early recognition and targeted interventions may be necessary to prevent the negative consequences of ADHD.

ARTICLE HIGHLIGHTS

Research background

The co-occurrence of attention-deficit hyperactivity disorder (ADHD) and substance use disorders, such as alcohol use disorder (AUD) and drug use disorder (DUD), has been studied in a variety of clinical and research settings. It is still unclear whether an increased risk of abuse or dependence applies to all forms of substance use to the same extent.

Research motivation

We have yet to fully understand the magnitude and nature of substance use among the adult population with ADHD. By obtaining more knowledge about the prevalence of AUD and DUD in adults with ADHD and the associations with clinical features of ADHD, this information can lead to hypotheses as to why some people with ADHD are at greater risk of developing substance use disorder.

Research objectives

To estimate the prevalence of AUD and DUD in adults with ADHD, and to estimate the associations with ADHD symptom severity and emotional dysregulation.

Research methods

This was an observational cross-sectional clinical study with a study sample consisting of 585 adult ADHD patients, who were admitted to a private psychiatric outpatient clinic over a 5-year period. ADHD was diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition criteria. AUD and DUD were diagnosed using the Mini International Neuropsychiatric Interview. ADHD severity was assessed by the Adult ADHD Self Report Scale. Emotional dysregulation was assessed by the 8-item version of Barkley's Current Behavior Scale - Self Report.

Research results

The 12-mo prevalences of AUD and DUD were 5.3% and 13.7%, respectively. The lifetime prevalence was 12.0% for AUD and 27.7% for DUD. A history of DUD but not AUD was positively associated with hyperactivity-impulsivity ADHD core symptoms, as well as emotional dysregulation.

Research conclusions

Compared to findings in the normal population, adult ADHD patients had much higher prevalence of past or current DUD but not AUD. DUD was particularly related to amphetamine and cannabis. Associations of DUD with clinical features of ADHD point to self-medication of ADHD as a possible causative factor and suggest early diagnosis and treatment of ADHD as a preventive strategy against substance abuse.

Research perspectives

Future research should be supplemented by longitudinal studies of children and adolescents with ADHD to investigate who develops substance use disorders. The effect of early ADHD treatment on substance abuse can be investigated by intervention studies.

REFERENCES

- 1 DSM-5 2013: Diagnostic and statistical manual of mental disorders (DSM-5®). 2013: American Psychiatric Association. Pub [DOI: [10.1176/appi.books.9780890425596.x00diagnosticclassification](https://doi.org/10.1176/appi.books.9780890425596.x00diagnosticclassification)]
- 2 Thapar A, Cooper M, Eyre O, Langley K. What have we learnt about the causes of ADHD? *J Child Psychol Psychiatry* 2013; **54**: 3-16 [PMID: [22963644](https://pubmed.ncbi.nlm.nih.gov/22963644/) DOI: [10.1111/j.1469-7610.2012.02611.x](https://doi.org/10.1111/j.1469-7610.2012.02611.x)]
- 3 Faraone SV, Larsson H. Genetics of attention deficit hyperactivity disorder. *Mol Psychiatry* 2019; **24**: 562-575 [PMID: [29892054](https://pubmed.ncbi.nlm.nih.gov/29892054/) DOI: [10.1038/s41380-018-0070-0](https://doi.org/10.1038/s41380-018-0070-0)]
- 4 Archer T, Oscar-Berman M, Blum K. Epigenetics in Developmental Disorder: ADHD and Endophenotypes. *J Genet Syndr Gene Ther* 2011; **2** [PMID: [22224195](https://pubmed.ncbi.nlm.nih.gov/22224195/) DOI: [10.4172/2157-7412.1000104](https://doi.org/10.4172/2157-7412.1000104)]
- 5 Fayyad J, De Graaf R, Kessler R, Alonso J, Angermeyer M, Demyttenaere K, De Girolamo G, Haro JM, Karam EG, Lara C, Lépine JP, Ormel J, Posada-Villa J, Zaslavsky AM, Jin R. Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *Br J Psychiatry* 2007; **190**: 402-409 [PMID: [17470954](https://pubmed.ncbi.nlm.nih.gov/17470954/) DOI: [10.1192/bjp.bp.106.034389](https://doi.org/10.1192/bjp.bp.106.034389)]
- 6 Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, Faraone SV, Greenhill LL, Howes MJ, Secnik K, Spencer T, Ustun TB, Walters EE, Zaslavsky AM. The prevalence and correlates of adult

- ADHD in the United States: results from the National Comorbidity Survey Replication. *Am J Psychiatry* 2006; **163**: 716-723 [PMID: 16585449 DOI: 10.1176/ajp.2006.163.4.716]
- 7 Willcutt EG, Nigg JT, Pennington BF, Solanto MV, Rohde LA, Tannock R, Loo SK, Carlson CL, McBurnett K, Lahey BB. Validity of DSM-IV attention deficit/hyperactivity disorder symptom dimensions and subtypes. *J Abnorm Psychol* 2012; **121**: 991-1010 [PMID: 22612200 DOI: 10.1037/a0027347]
 - 8 Cortese S, Faraone SV, Bernardi S, Wang S, Blanco C. Gender differences in adult attention-deficit/hyperactivity disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). *J Clin Psychiatry* 2016; **77**: e421-e428 [PMID: 27137426 DOI: 10.4088/JCP.14m09630]
 - 9 Biederman J, Monuteaux MC, Mick E, Spencer T, Wilens TE, Silva JM, Snyder LE, Faraone SV. Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. *Psychol Med* 2006; **36**: 167-179 [PMID: 16420713 DOI: 10.1017/S0033291705006410]
 - 10 Wilens TE. The nature of the relationship between attention-deficit/hyperactivity disorder and substance use. *J Clin Psychiatry* 2007; **68** Suppl 11: 4-8 [PMID: 18307375]
 - 11 Charach A, Yeung E, Climans T, Lillie E. Childhood attention-deficit/hyperactivity disorder and future substance use disorders: comparative meta-analyses. *J Am Acad Child Adolesc Psychiatry* 2011; **50**: 9-21 [PMID: 21156266 DOI: 10.1016/j.jaac.2010.09.019]
 - 12 Solberg BS, Halmøy A, Engeland A, Igland J, Haavik J, Klungsøyr K. Gender differences in psychiatric comorbidity: a population-based study of 40 000 adults with attention deficit hyperactivity disorder. *Acta Psychiatr Scand* 2018; **137**: 176-186 [PMID: 29266167 DOI: 10.1111/acps.12845]
 - 13 Vogel T, Dom G, van de Glind G, Studer J, Gmel G, Strik W, Moggi F. Is attention deficit/hyperactivity disorder among men associated with initiation or escalation of substance use at 15-month follow-up? A longitudinal study involving young Swiss men. *Addiction* 2016; **111**: 1867-1878 [PMID: 27061514 DOI: 10.1111/add.13422]
 - 14 Fatséas M, Hurmic H, Serre F, Debrabant R, Daulouède JP, Denis C, Auriacombe M. Addiction severity pattern associated with adult and childhood Attention Deficit Hyperactivity Disorder (ADHD) in patients with addictions. *Psychiatry Res* 2016; **246**: 656-662 [PMID: 27842945 DOI: 10.1016/j.psychres.2016.10.071]
 - 15 Young JT, Carruthers S, Kaye S, Allsop S, Gilsean J, Degenhardt L, van de Glind G, van den Brink W, Preen D. Comorbid attention deficit hyperactivity disorder and substance use disorder complexity and chronicity in treatment-seeking adults. *Drug Alcohol Rev* 2015; **34**: 683-693 [PMID: 25790353 DOI: 10.1111/dar.12249]
 - 16 Capusan AJ, Bendtsen P, Marteinsdottir I, Larsson H. Comorbidity of Adult ADHD and Its Subtypes With Substance Use Disorder in a Large Population-Based Epidemiological Study. *J Atten Disord* 2019; **23**: 1416-1426 [PMID: 26838558 DOI: 10.1177/1087054715626511]
 - 17 Shaw P, Stringaris A, Nigg J, Leibenluft E. Emotion dysregulation in attention deficit hyperactivity disorder. *Am J Psychiatry* 2014; **171**: 276-293 [PMID: 24480998 DOI: 10.1176/appi.ajp.2013.13070966]
 - 18 Connor DF, Steeber J, McBurnett K. A review of attention-deficit/hyperactivity disorder complicated by symptoms of oppositional defiant disorder or conduct disorder. *J Dev Behav Pediatr* 2010; **31**: 427-440 [PMID: 20535081 DOI: 10.1097/DBP.0b013e3181e121bd]
 - 19 Landaas ET, Halmøy A, Oedegaard KJ, Fasmer OB, Haavik J. The impact of cyclothymic temperament in adult ADHD. *J Affect Disord* 2012; **142**: 241-247 [PMID: 22840630 DOI: 10.1016/j.jad.2012.04.034]
 - 20 Barkley RA, Fischer M. The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. *J Am Acad Child Adolesc Psychiatry* 2010; **49**: 503-513 [PMID: 20431470 DOI: 10.1097/00004583-201005000-00011]
 - 21 Faraone SV, Rostain AL, Blader J, Busch B, Childress AC, Connor DF, Newcorn JH. Practitioner Review: Emotional dysregulation in attention-deficit/hyperactivity disorder - implications for clinical recognition and intervention. *J Child Psychol Psychiatry* 2019; **60**: 133-150 [PMID: 29624671 DOI: 10.1111/jcpp.12899]
 - 22 Reimherr FW, Roesler M, Marchant BK, Gift TE, Retz W, Philipp-Wiegmann F, Reimherr ML. Types of Adult Attention-Deficit/Hyperactivity Disorder: A Replication Analysis. *J Clin Psychiatry* 2020; **81** [PMID: 32220152 DOI: 10.4088/JCP.19m13077]
 - 23 Gisbert L, Vilar L, Rovira P, Sánchez-Mora C, Pagerols M, Garcia-Martínez I, Richarte V, Corrales M, Casas M, Ramos-Quiroga JA, Soler Artigas M, Ribasés M. Genome-wide analysis of emotional lability in adult attention deficit hyperactivity disorder (ADHD). *Eur Neuropsychopharmacol* 2019; **29**: 795-802 [PMID: 31085060 DOI: 10.1016/j.euroneuro.2019.04.004]
 - 24 Aldao A, Gee DG, De Los Reyes A, Seager I. Emotion regulation as a transdiagnostic factor in the development of internalizing and externalizing psychopathology: Current and future directions. *Dev Psychopathol* 2016; **28**: 927-946 [PMID: 27739387 DOI: 10.1017/S0954579416000638]
 - 25 Schreiber LR, Grant JE, Odlaug BL. Emotion regulation and impulsivity in young adults. *J Psychiatr Res* 2012; **46**: 651-658 [PMID: 22385661 DOI: 10.1016/j.jpsychires.2012.02.005]
 - 26 Sobanski E, Banaschewski T, Asherson P, Buitelaar J, Chen W, Franke B, Holtmann M, Krumm B, Sergeant J, Sonuga-Barke E, Stringaris A, Taylor E, Anney R, Ebstein RP, Gill M, Miranda A, Mulas F, Oades RD, Roeyers H, Rothenberger A, Steinhausen HC, Faraone SV. Emotional lability in children and adolescents with attention deficit/hyperactivity disorder (ADHD): clinical correlates and familial prevalence. *J Child Psychol Psychiatry* 2010; **51**: 915-923 [PMID: 20132417 DOI: 10.1111/j.1469-7610.2010.02217.x]
 - 27 Evren C, Karabulut V, Alniak I, Evren B, Carkci OH, Yilmaz Cengel H, Ozkara Menekseoglu P, Cetin T, Bozkurt M, Umut G. Emotion dysregulation and internalizing symptoms affect relationships between ADHD symptoms and borderline personality features among male patients with substance use disorders. *Psychiatry and Clinical Psychopharmacology* 2019; **29**: 696-706 [DOI: 10.1080/24750573.2019.1595271]
 - 28 Kooij JJS, Francken MH. Diagnostic interview for ADHD in adults 2.0 (DIVA 2.0). Adult ADHD: Diagnostic assessment and treatment, 33-99 [DOI: 10.1007/978-1-4471-4138-9_3]
 - 29 Sheehan DV, Lecrubier Y, Sheehan KH, Janavs J, Weiller E, Keskiner A, Schinka J, Knapp E, Sheehan M, Dunbar G. The validity of the Mini International Neuropsychiatric Interview (MINI) according to the SCID-P and its reliability. *Eur Psychiatry* 1997; **12**: 232-41 [DOI: 10.1016/S0924-9338(97)83297-X]

- 30 **Sheehan DV**, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, Hergueta T, Baker R, Dunbar GC. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry* 1998; **59** Suppl 20: 22-33; quiz 34-57 [PMID: [9881538](#) DOI: [10.1037/t18597-000](#)]
- 31 **Silverstein MJ**, Alperin S, Faraone SV, Kessler RC, Adler LA. Test-retest reliability of the adult ADHD Self-Report Scale (ASRS) v1.1 Screener in non-ADHD controls from a primary care physician practice. *Fam Pract* 2018; **35**: 336-341 [PMID: [29177453](#) DOI: [10.1093/fampra/cmxx115](#)]
- 32 **Fredriksen M**, Dahl AA, Martinsen EW, Klungsoyr O, Haavik J, Peleikis DE. Effectiveness of one-year pharmacological treatment of adult attention-deficit/hyperactivity disorder (ADHD): an open-label prospective study of time in treatment, dose, side-effects and comorbidity. *Eur Neuropsychopharmacol* 2014; **24**: 1873-1884 [PMID: [25453480](#) DOI: [10.1016/j.euroneuro.2014.09.013](#)]
- 33 **Barkley RA**. Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychol Bull* 1997; **121**: 65-94 [PMID: [9000892](#) DOI: [10.1037/0033-2909.121.1.65](#)]
- 34 **Barkley RA**, Murphy KR, Robison RJ, Reimherr FW, Marchant BK, Kondo D, Coon H, Rosen PJ, Epstein JN. Deficient emotional self-regulation in adults with Attention deficit Hyperactive Disorder (ADHD): The Relative Contribution of Emotional Impulsiveness and ADHD symptoms to Adaptive Impairment in Major Life Activities. *J ADHD Related Disorders* 2010; **1**: 5-28 [DOI: [10.1521/adhd.2010.18.4.1](#)]
- 35 **Surman CB**, Biederman J, Spencer T, Miller CA, Petty CR, Faraone SV. Neuropsychological Deficits Are Not Predictive of Deficient Emotional Self-Regulation in Adults With ADHD. *J Atten Disord* 2015; **19**: 1046-1053 [PMID: [23503813](#) DOI: [10.1177/1087054713476548](#)]
- 36 **IBM Corp.** IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. 2013 [DOI: [10.4135/9781526435439](#)]
- 37 **Grant BF**, Goldstein RB, Saha TD, Chou SP, Jung J, Zhang H, Pickering RP, Ruan WJ, Smith SM, Huang B, Hasin DS. Epidemiology of DSM-5 Alcohol Use Disorder: Results From the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry* 2015; **72**: 757-766 [PMID: [26039070](#) DOI: [10.1001/jamapsychiatry.2015.0584](#)]
- 38 **Rehm J**, Room R, van den Brink W, Jacobi F. Alcohol use disorders in EU countries and Norway: an overview of the epidemiology. *Eur Neuropsychopharmacol* 2005; **15**: 377-388 [PMID: [15925491](#) DOI: [10.1016/j.euroneuro.2005.04.005](#)]
- 39 **Bratberg GH**, C Wilsnack S, Wilsnack R, Håvås Haugland S, Krokstad S, Sund ER, Bjørngaard JH. Gender differences and gender convergence in alcohol use over the past three decades (1984-2008), The HUNT Study, Norway. *BMC Public Health* 2016; **16**: 723 [PMID: [27492155](#) DOI: [10.1186/s12889-016-3384-3](#)]
- 40 **Grant BF**, Saha TD, Ruan WJ, Goldstein RB, Chou SP, Jung J, Zhang H, Smith SM, Pickering RP, Huang B, Hasin DS. Epidemiology of DSM-5 Drug Use Disorder: Results From the National Epidemiologic Survey on Alcohol and Related Conditions-III. *JAMA Psychiatry* 2016; **73**: 39-47 [PMID: [26580136](#) DOI: [10.1001/jamapsychiatry.2015.2132](#)]
- 41 **Kendler KS**, Aggen SH, Tambs K, Reichborn-Kjennerud T. Illicit psychoactive substance use, abuse and dependence in a population-based sample of Norwegian twins. *Psychol Med* 2006; **36**: 955-962 [PMID: [16650346](#) DOI: [10.1017/S0033291706007720](#)]
- 42 **Kringle E**, Torgersen S, Cramer V. A Norwegian psychiatric epidemiological study. *Am J Psychiatry* 2001; **158**: 1091-1098 [PMID: [11431231](#) DOI: [10.1176/appi.ajp.158.7.1091](#)]
- 43 **Demontis D**, Walters RK, Martin J, Mattheisen M, Als TD, Agerbo E, Baldursson G, Belliveau R, Bybjerg-Grauholm J, Bækvad-Hansen M, Cerrato F, Chambert K, Churchhouse C, Dumont A, Eriksson N, Gandal M, Goldstein JI, Grasby KL, Grove J, Gudmundsson OO, Hansen CS, Hauberg ME, Hollegaard MV, Howrigan DP, Huang H, Maller JB, Martin AR, Martin NG, Moran J, Pallesen J, Palmer DS, Pedersen CB, Pedersen MG, Poterba T, Poulsen JB, Ripke S, Robinson EB, Satterstrom FK, Stefansson H, Stevens C, Turley P, Walters GB, Won H, Wright MJ; ADHD Working Group of the Psychiatric Genomics Consortium (PGC); Early Lifecourse & Genetic Epidemiology (EAGLE) Consortium; 23andMe Research Team, Andreassen OA, Asherson P, Burton CL, Boomsma DI, Cormand B, Dalsgaard S, Franke B, Gelernter J, Geschwind D, Hakonarson H, Haavik J, Kranzler HR, Kuntsi J, Langley K, Lesch KP, Middeldorp C, Reif A, Rohde LA, Roussos P, Schachar R, Sklar P, Sonuga-Barke EJS, Sullivan PF, Thapar A, Tung JY, Waldman ID, Medland SE, Stefansson K, Nordentoft M, Hougaard DM, Werge T, Mors O, Mortensen PB, Daly MJ, Faraone SV, Børglum AD, Neale BM. Discovery of the first genome-wide significant risk loci for attention deficit/hyperactivity disorder. *Nat Genet* 2019; **51**: 63-75 [PMID: [30478444](#) DOI: [10.1038/s41588-018-0269-7](#)]
- 44 **Wang K**, Gaitsch H, Poon H, Cox NJ, Rzhetsky A. Classification of common human diseases derived from shared genetic and environmental determinants. *Nat Genet* 2017; **49**: 1319-1325 [PMID: [28783162](#) DOI: [10.1038/ng.3931](#)]
- 45 **Sanchez-Roige S**, Fontanillas P, Elson SL; 23andMe Research Team, Gray JC, de Wit H, Davis LK, MacKillop J, Palmer AA. Genome-wide association study of alcohol use disorder identification test (AUDIT) scores in 20 328 research participants of European ancestry. *Addict Biol* 2019; **24**: 121-131 [PMID: [29058377](#) DOI: [10.1111/adb.12574](#)]
- 46 **Thapar A**, Langley K, Asherson P, Gill M. Gene-environment interplay in attention-deficit hyperactivity disorder and the importance of a developmental perspective. *Br J Psychiatry* 2007; **190**: 1-3 [PMID: [17197648](#) DOI: [10.1192/bjp.bp.106.027003](#)]
- 47 **Wilens TE**. Impact of ADHD and its treatment on substance abuse in adults. *J Clin Psychiatry* 2004; **65** Suppl 3: 38-45 [PMID: [15046534](#)]
- 48 **Wilens TE**, Adamson J, Sgambati S, Whitley J, Santry A, Monuteaux MC, Biederman J. Do individuals with ADHD self-medicate with cigarettes and substances of abuse? Results from a controlled family study of ADHD. *Am J Addict* 2007; **16** Suppl 1: 14-21; quiz 22-3 [PMID: [17453603](#) DOI: [10.1080/10550490601082742](#)]
- 49 **Brandt A**, Rehm J, Lev-Ran S. Clinical Correlates of Cannabis Use Among Individuals With Attention Deficit Hyperactivity Disorder. *J Nerv Ment Dis* 2018; **206**: 726-732 [PMID: [30124577](#) DOI: [10.1097/NMD.0000000000000877](#)]
- 50 **Vildalen VU**, Brevik EJ, Haavik J, Lundervold AJ. Females With ADHD Report More Severe Symptoms

Than Males on the Adult ADHD Self-Report Scale. *J Atten Disord* 2019; **23**: 959-967 [PMID: 27461728 DOI: 10.1177/1087054716659362]

- 51 **Robison RJ**, Reimherr FW, Marchant BK, Faraone SV, Adler LA, West SA. Gender differences in 2 clinical trials of adults with attention-deficit/hyperactivity disorder: a retrospective data analysis. *J Clin Psychiatry* 2008; **69**: 213-221 [PMID: 18211131 DOI: 10.4088/JCP.v69n0207]
- 52 **Ceetham A**, Allen NB, Yücel M, Lubman DI. The role of affective dysregulation in drug addiction. *Clin Psychol Rev* 2010; **30**: 621-634 [PMID: 20546986 DOI: 10.1016/j.cpr.2010.04.005]

RESEARCH

Open Access



Prevalence of criminal convictions in Norwegian adult ADHD outpatients and associations with ADHD symptom severity and emotional dysregulation

Espen Anker^{1*}, Ylva Ginsberg² and Trond Heir³

Abstract

Objectives: Attention deficit hyperactivity disorder (ADHD) often co-occurs with antisocial behaviour. Several studies have shown high rates of ADHD among prisoners. However, the prevalence of crime among individuals with ADHD is less known. The aim of the present study was to estimate the prevalence of lifetime criminal conviction (CC) in a clinical sample of adults with ADHD, and the associations with the severity of ADHD and emotional dysregulation (ED).

Methods: Patients were admitted to a private psychiatric outpatient clinic in Oslo between 2014 and 2018. Of the 656 patients diagnosed with ADHD, 629 (95.9%) agreed to participate in the study. CC was determined based on self-reporting of the lifetime history of criminal behaviour. ADHD was diagnosed according to the DSM-5 criteria, and ADHD severity was measured using the Adult ADHD Self-Report Scale (ASRS). ED was assessed by the eight-item version of Barkley's Current Behaviour Scale - Self-Report (CBS-SR).

Results: The prevalence of self-reported CC in this clinical sample was 11.7% among women and 24.5% among men. CC was associated with hyperactive-impulsive severity ($p < 0.001$) and ED ($p = 0.006$).

Conclusions: The prevalence of self-reported lifetime criminal conviction was high for both genders. CC was associated with symptom severity of hyperactivity-impulsivity and emotional dysregulation. The findings suggest the need for greater research efforts on the avoidance of criminal activity in people with ADHD and targeted intervention for ADHD treatment and CC prevention.

Keywords: ADHD severity, Offending, Deficient emotional self-regulation, Emotional dysregulation, Criminal conviction, Antisocial behaviour, Substance use disorder

Introduction

Attention deficit hyperactivity disorder (ADHD) often co-occurs with antisocial behaviour [1, 2]. Several studies have estimated that the prevalence of ADHD among male inmates ranges from 15 to 50% [3–7]. Meta-analyses have indicated an average prevalence of

approximately 25% in male inmates [8, 9], and even as high as 40% in female inmates [10]. These rates far exceed the estimated 3–5% prevalence rates of ADHD in the general adult population [11, 12].

Longitudinal studies have found that children with ADHD have a high risk of later antisocial activity and criminal conviction (CC) in adulthood [13, 14]. The long-term outcomes of Danish children with ADHD indicated that nearly half had a history of CC in adulthood

* Correspondence: espen.anker@online.no

¹Oslo ADHD Clinic, Kirkeveien 64B, 0366 Oslo, Norway

Full list of author information is available at the end of the article



© The Author(s). 2021 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

[15]. Other studies found girls with ADHD to have seven times higher odds of having an incarceration record than non-ADHD girls, while boys with ADHD had two times higher odds [16]. A Swedish national register-based study found that 15.4% of women and 36.6% of men with ADHD were convicted of any crime [17]. There is a lack of studies comparing CC and no-CC as an outcome for both genders [18].

Knowledge of the prevalence of CC in an ADHD outpatient clinic may be helpful for health authorities to plan appropriate services and help clinicians plan specialized treatments for adult ADHD. Measurements of the prevalence of CC may also contribute to the elucidation of possible causes and the achievement of treatment.

Several studies have indicated that CC and antisocial behaviour are correlated with the severity of ADHD [2, 19–23], and we aimed to confirm this in our study.

Previous studies have found general adjustment problems to be linked to antisocial behaviour in adults with ADHD [24]. Antisocial behaviour is largely mediated by emotional lability and anger problems [25]. Excessive and inappropriate emotional expressions, irritability, and temper outbursts may be recorded as clinical expressions of emotional dysregulation (ED) [26, 27]. ED is a common feature in ADHD, even though it is not part of the criteria of the disorder [28–37]. ED, irrespective of ADHD, is associated with aggressive and violent criminality [38]. ED in adults is clinically similar to oppositional defiant disorder in youth, which has been linked to antisocial behaviour [39, 40]. Whether the severity of ED is associated with CC has yet to be shown.

The aims of the present study were to estimate the prevalence of CC in a clinical sample of outpatients with ADHD and to examine its associations with ADHD symptom severity and ED.

Method

This was an observational cross-sectional clinical study.

Participants

The study population consisted of adult outpatients aged 18 to 65 who were not imprisoned who fulfilled the diagnostic criteria for a diagnosis of ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [41]. Patients were admitted to a private outpatient non-inmate psychiatric clinic in Oslo, Norway, specializing in the clinical assessment and treatment of adults with ADHD.

Recruitment was conducted between 2014 and 2018. ADHD was assessed using DIVA 2.0 the semi-structured Diagnostic Interview for Adult ADHD, second edition [42]. The assessment was performed by a psychiatrist for all patients included in the study. DIVA 2.0 is a reliable

tool for assessing and diagnosing adult ADHD [43]. During the study period, 656 of the assessed patients fulfilled the diagnostic criteria for ADHD and were invited to participate in the study, of whom 65% were self-referred and 35% were referred by healthcare practitioners. None of the participants were using prescribed stimulant medication at the time of assessment. There were no exclusion criteria.

Of the 656 patients (351 men and 305 women) with ADHD, 629 (95.9%) gave written informed consent to participate in the study. The study was approved by the Regional Medical Ethics Committee, South-East Norway, 2015/426. Assessments were carried out in accordance with ethical standards, and the principals of the Declaration of Helsinki.

Measures

The age of the participants was recorded as their respective numbers of lived years when entering the study. Gender was recorded as 'woman' or 'man' based on information revealed by the participant. Sociodemographic information was collected as follows: Participant was married or cohabitating. If a participant was living with children inclusive partial custody, but not even though having children somewhere else. Educational level was categorized based on the number of years in education: 12 years or less, 13–15 years, or more than 15 years. Work participation was defined as 'yes' if work was reported as the main source of income.

Criminal conviction (CC) was defined as being convicted by the court of any crime under Norwegian law. CC was recorded as positive when participants self-reported CC in response to the following question: 'Have you ever been in prison or been convicted for any crime?'. We also recorded which crime they were convicted of.

ADHD symptom severity was measured by the Adult ADHD Self-Report Scale (ASRS) Symptom Check List, v1.1 [44, 45]. The ASRS is a reliable and valid screening instrument for evaluating ADHD in adults [46]. The 18-item version yields a score ranging from 0 to 72 points. We recorded scores of the subscales of the ASRS questionnaire, i.e., inattentive items (items 1–4 and 7–11) and hyperactivity - impulsivity items (items 5, 6, and 12–18) separately [47].

Emotion dysregulation covers a large variety of emotion dysregulated responses as overwhelming sadness, anxiety, fear, suicidal actions, plural emotional outbursts, and is also linked to several other diagnoses as depression and anxiety (Dvir et al. 2014 [48]), PTSD and personality disorders (Ford & Cortious 2014 [49]), brain injury (Fisher et al. 2015 [50]) or dementia (Ismail et al. 2018 [51]).

Emotion dysregulation in ADHD could alternatively have been assessed by the Impulsivity/Emotional Lability scale from the Conners' Adult ADHD Rating Scales (CAARS) (Conners et al. 1999 [52]) a 12-item subscale which assesses temper, irritability, stress intolerance and labile mood, but in our paper the definition of emotional dysregulation (ED) was narrowed down to measure explosive anger, temper, or irritability according to Russell Barkley [53]. ED was assessed by using eight relevant items from the larger Current Behaviour Scale - Self Report, known as the Deficient Emotional Self-Regulation (DESR) questionnaire [32, 34, 53, 54]. The eight items were as follows: 1: Quick to get angry or become upset; 2: Easily frustrated; 3: Overreact emotionally; 4: Easily excited by activities going on around me; 5: Lose my temper; 6: Argue with others; 7: Am touchy or easily annoyed by others; and 8: Am angry or resentful. The items were marked by participant as never or rarely (0), sometimes (1), often (2) or very often (3). This yielded a total ED score ranging from 0 to 24.

Alcohol and drug use disorders were diagnosed using a module of the Mini International Neuropsychiatric Interview (M.I.N.I.), Norwegian Translation Version 6.0.0, according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria [55, 56]. Dependence and abuse were merged into 'use' disorder (as in M.I.N.I. version 7.0/DSM-5), and questions were asked regarding both the last 12-months and lifetime prevalence.

Statistical analysis

Numbers with percent proportions (%) are reported for all categorical variables. Means with standard deviations (SD) are given for continuous variables. We used chi-square (χ^2) tests to compare categorical variables and independent sample T-tests to compare continuous variables. We used logistic regression analyses to examine the associations between CC as the outcome variable and age, gender, ADHD symptom severity and ED as the independent variables. To avoid bias in the regression analysis we have decided not to control for probable intermediate variables (or a proxy for an intermediate variable) in the causal pathway between ADHD severity or ED and criminal behaviour (Rothman & Greenland 1998 [57], Gilthorpe et al. 2015 [58], Schisterman et al. 2009 [59]). For example, we have previously published results from the same study sample showing that ADHD severity and ED are associated with alcohol and drug use disorders (Anker et al. 2020 [60]). Both ADHD and ED are early acquired and stable features of a person's emotional and behaviour reaction patterns less influenced by external circumstances (DSM-5, Eisenberg et al. 2010 [61]) and can be interpreted as causal in these relationships. Also, it is well known that alcohol and drug use

are strong risk factors for criminal behaviour (Dowden & Brown 2002 [62]). Thus, alcohol and drug use disorders appear to be intermediate variables in the causal pathway between ADHD or ED and criminal behaviour, or they may be a proxy for an intermediate variable in the causal pathway, such as a high-risk social environment. The same argument applies to several variables listed in Table 1, such as education, family relationships and work. Intermediate variables (or a proxy for an intermediate variable), if controlled in an analysis, would usually bias results towards the null, which in the literature is described as a form of overadjustment that should be avoided (Rothman & Greenland 1998 [57], Gilthorpe et al. 2015 [58], Schisterman et al. 2009 [59]).

All tests were two-tailed, and differences were considered significant if $p < 0.05$. There were no missing data. All statistical analyses were performed using the software package IBM 2016 SPSS version 22 [63]. We used Cronbach's alpha statistic to assess the internal consistency reliability of the eight items from the DESR scale. Cronbach's alpha for the eight scale items in our sample was 0.86 indicating high internal consistency.

Results

Table 1 shows participants with and without a history of criminal conviction (CC). Those with a history of CC were older, were more often men, had a lower educational level, were less involved in family life and work, and had a higher risk of a history of alcohol or drug use disorders than those without a history of CC.

The prevalence of CC was 11.7% ($n = 34$) in women and 24.5% ($n = 83$) in men.

Among women ($n = 290$), the most common conviction was for selling or possessing drugs ($n = 18$; 6.2%), followed by violence, ($n = 6$; 2.1%), traffic crime ($n = 6$; 2.1%), theft ($n = 2$; 0.7%), and mixed or multiple convictions ($n = 2$; 0.7%).

Among men ($n = 339$), the most common conviction was for selling or possessing drugs ($n = 32$; 9.4%), followed by violence, ($n = 24$; 7.1%), traffic crime ($n = 14$; 4.1%), theft ($n = 5$; 1.5%), and mixed or multiple convictions ($n = 8$; 2.4%).

Hyperactive-impulsive symptom severity and ED were higher in patients who had a history of CC (Table 1).

Table 2 shows associations between criminal conviction (CC) as the outcome variable and age, gender, ADHD symptom severity and emotional dysregulation (ED) as independent variables. Higher levels of hyperactivity-impulsivity symptoms and ED were significantly associated with CC bivariate as well as in multivariate logistic regression model adjusted for age and gender.

There were no significant interactions among age, gender, hyperactive-impulsive symptom severity and ED.

Table 1 Demographics and clinical features in a sample of adult ADHD patients with and without a history of criminal conviction. Participants were recruited in an outpatient psychiatric clinic specialized in examination and treatment of ADHD

	Total sample n = 629	Criminal Conviction n = 117	No-Criminal Conviction n = 512	p-value
Age, mean yrs. (SD)	36.7 (11.4)	39.8 (10.0)	35.9 (11.6)	0.020
Gender: Women, n (%)	290 (46.1)	34 (29.1)	256 (50.0)	< 0.001
Men, n (%)	339 (53.9)	83 (70.9)	256 (50.0)	
Years of education: ≤ 12: (%)	321 (51.0)	92 (78.6)	229 (44.7)	< 0.001
13–15: (%)	248 (39.4)	24 (20.5)	224 (43.8)	
> 15: (%)	60 (9.5)	1 (0.9)	59 (11.5)	
Married or cohabitant, n (%)	270 (42.9)	38 (32.5)	232 (45.3)	0.014
Living with children, n (%)	248 (39.4)	30 (25.6)	218 (42.8)	0.003
Work participation, n (%)	370 (58.8)	49 (41.9)	321 (62.7)	< 0.001
Alcohol use disorder lifetime, n (%)	73 (11.6)	29 (24.8)	44 (8.6)	< 0.001
Drug use disorder lifetime, n (%)	165 (26.2)	81 (69.2)	84 (16.4)	< 0.001
Inattentiveness, mean (SD)	27.4 (4.7)	27.9 (5.1)	27.3 (4.6)	0.036
Hyperactivity-Impulsivity, mean (SD)	23.9 (6.6)	26.7 (5.8)	23.3 (6.6)	< 0.001
Emotional Dysregulation, mean (SD)	12.1 (5.6)	14.0 (5.6)	11.8 (5.5)	< 0.001

p-values are due to comparison of ADHD patients with and without a history of criminal conviction (chi-square or t-test)

Discussion

The study revealed a high incidence of crime among adult ADHD patients. The 11.7 and 24.5% life-time prevalence rates of criminal conviction (CC) in female and male ADHD patients respectively, were considerably higher than the correspondingly 1 and 5% rates for women and men in the general Norwegian population [64]. High risk of crime in people with ADHD is also known from other Scandinavian countries with relatively low incidences of crime in the general population [17, 65].

The two or threefold higher risk of CC among men versus women is in line with other studies of ADHD patients [7, 16, 65]. The ratio is similar to that in the general population [64, 66], which indicates that gender differences are not affected by ADHD.

The finding that CC was associated with the severity of hyperactive-impulsive symptoms is in line with several studies that have shown associations between the

severity of ADHD symptoms and different aspects of antisocial behaviour [25, 67–71]. This finding is also consistent with longitudinal studies of children with ADHD showing that the severity of hyperactivity-impulsivity symptoms was associated with later occurrence of CC [64, 72]. It is likely that restlessness and impulsivity symptoms may result in less well-considered behaviour that may also include violation of the law. It is also possible that criminal acts by people with hyperactive-impulsive symptoms are more due to sensation and novelty seeking [73, 74] and less planned and proactive and that people with ADHD are therefore more likely to be convicted [75].

With this aspect in mind, it seems meaningful to address the severity of ADHD as emphasized in the DSM-5 [41] as opposed to categorizing ADHD by sub-type as suggested in the DSM-IV [76]. The strong association between CC and hyperactive-impulsive severity also underlines the importance of treating ADHD as a

Table 2 Associations between criminal conviction (CC) as the outcome variable and age, gender, ADHD symptom severity and emotional dysregulation (ED) as independent variables in a clinical sample of adult females (n = 290) and males (n = 339) with ADHD

	Unadjusted			Adjusted		
	OR	95%CI	p-value	OR	95%CI	p-value
Age (increase in 10 years)	1.34	1.13–1.60	0.001	1.32	1.10–1.59	0.003
Gender (Men v. Women)	2.44	1.58–7.77	< 0.001	3.38	2.12–5.39	< 0.001
ADHD symptom severity						
Inattentiveness	1.03	0.98–1.07	0.28	0.96	0.91–1.02	0.17
Hyperactivity-Impulsivity	1.09	1.05–1.12	< 0.001	1.09	1.04–1.13	< 0.001
Emotional dysregulation	1.08	1.04–1.12	< 0.001	1.07	1.02–1.12	0.006

Results are given as odds ratios (ORs) with 95% confidence intervals (95%CI) in bivariate (unadjusted) and multivariate (adjusted) logistic regression models

dimensional diagnosis and expecting more antisocial behaviour in patients presenting with high levels of hyperactive-impulsive symptoms.

The concept of emotional dysregulation (ED) has different aspects, with both bottom-up strong emotional responses and top-down poorer regulation of emotions. The DESR questionnaire is mostly focused on bottom-up emotionality, which has been understood as ED. In our sample, CC was associated with the severity of ED, independent of hyperactive-impulsive severity. We suggest that knowledge on ED does add significantly to the understanding of CC in people with ADHD. First, ED is a common feature of ADHD, even though it is not part of the diagnostic criteria [28–37, 77]. Second, ED contributes significantly to general impairments in patients with ADHD [78] and has an independent effect on general social problems associated with ADHD [34, 79]. Third, aggression in childhood has been found to predict criminality later in life [72], and personality traits of negative emotionality have been linked to criminal activity [80]. Adding ED severity to the concept of ADHD is in line with Reimherr et al., who emphasize a two-factor solution for ADHD subgroups, with a presentation consisting solely of inattention and a more comprehensive hyperactivity-impulsivity-emotional dysregulation presentation [81].

We found a strong relationship between all background variables and CC. The association between low education and CC is notable since people with ADHD have lower levels of education than the general population [82–84]. Additionally, drug use disorder was correlated with CC, which is worth noting since ADHD patients have higher incidences of drug use than the general population [25, 60, 65, 85, 86].

The relationship between crime and substance use disorders may be due to several mechanisms. It is reasonable that substance use and addiction can lead to crime. On the other hand, criminal activity can provide closer contact with intoxicants and drug environments. In addition, there may be common underlying factors that increase the risk of both substance use and crime. The fact that we exclusively had lifetime prevalence for both substance use and CC, and lacked hypotheses of cause-effect, led us not to adjust for substance use in the regression model.

Early identification of ADHD and disruptive behaviour, with subsequent multimodal interventions might reduce the risk of a criminal trajectory. Supporting people with ADHD in attaining higher education and work and avoiding drugs is probably also a good approach to prevent CC.

There are some methodological limitations to consider in this study. CC was measured based on self-report, which may have resulted in under-reporting. Patients

attending a private clinic that is not governmentally funded may not be representative of patients with ADHD in general. They may have a higher socioeconomic status and be less impaired than patients in public outpatient clinics or prison inmates. Additionally, the prevalence rates of criminality and morbidity in this population may not be representative of those of the total ADHD patient population. We assume that differences in sample selection may primarily affect the prevalence rates and, to a lesser extent, their associations [87, 88]. The associations with CC should therefore be more generalizable.

The cross-sectional observational design limited the interpretation of causal relationships. We assume ADHD and ED are traits that develop in childhood before the criminal minimum age, which is 15 years in Norway, which may therefore indicate the direction of causality.

Conclusion

In this clinical sample the prevalence of criminal conviction (CC) was high for both genders compared to the prevalence rates reported in the general population. CC was associated with the severity of hyperactivity-impulsivity, as well as emotional dysregulation, which indicates that knowledge on both features contributes to the understanding of CC in ADHD.

Clinical implication

Criminal behaviour is common in adults with ADHD. The findings call for research efforts to prevent criminal activity in people with ADHD. The association of higher severity of hyperactivity-impulsivity symptoms and emotional dysregulation with CC suggests that clinical manifestations should be treated carefully. Early identification as well as biological- and psychological approaches in the prevention and treatment of ADHD and externalizing behaviour should be performed early in childhood and followed up in adulthood by professionals with specific knowledge of treatment and behavioural interactions with the environment. Furthermore, targeted interventions should focus on the preventive effect of academic achievement and higher education for adolescents with ADHD, which could be crucial in avoiding illegal drug use, antisocial behaviour, and criminal activity.

Abbreviations

ADHD: Attention Deficit Hyperactivity Disorder; ED: Emotional Dysregulation; MINI: Mini International Neuropsychiatric Interview; ASRS: Adult ADHD Self-Report Scale; CC: Criminal Conviction

Acknowledgements

We would like to thank Bothild Bendiksen, Susan Young and Gisli Gudjonsson for valuable input on the content.

Authors' contributions

EA and TH designed the study. EA collected and analysed the data. All the authors participated actively in the writing of the manuscript. All authors approved the final draft.

Funding

This work was economically supported by NevSom, Oslo University Hospital, grant number 51379. The funder had no other role in the study or writing the manuscript.

Availability of data and materials

Data were collected from a private psychiatric outpatient ward in Oslo. Public availability of the data would compromise privacy of the respondents. According to approval from the Norwegian Regional Committee for Medical and Health Research Ethics, the data must be stored properly in line with the Norwegian Law of Privacy Protection. However, anonymized data are freely available to interested researchers upon request, pending ethical approval from the ethics committee. Interested researchers can contact project leader Espen Anker (espen.anker@online.no) with requests for the data.

Declarations

We confirm that all methods were performed in accordance with relevant guidelines and regulations.

Ethics approval and consent to participate

The study was approved by the Regional Medical Ethics Committee, South-East D, Norway, 2015/426. Written consent to participate was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

EA has received speaker honoraria from Shire. TH report no competing interest. YG has received personal fees and non-financial support from Medscape, non-financial support from Shire, and personal fees from Studentlitteratur, all outside the submitted work.

Author details

¹Oslo ADHD Clinic, Kirkeveien 64B, 0366 Oslo, Norway. ²Centre for Psychiatry Research, Department of Clinical Neuroscience, Karolinska Institutet & Stockholm Health Care Services, Stockholm, Sweden. ³University of Oslo, Institute of Clinical Medicine, Oslo, Norway.

Received: 11 September 2020 Accepted: 19 April 2021

References

- Sourander A, Elonheimo H, Niemela S, Nuutila A-M, Helenius H, Sillanmaki L, et al. Childhood predictors of male criminality: a prospective population-based follow-up study from age 8 to late adolescence. *J Am Acad Child Adolesc Psychiatry*. 2006;45(5):578Y586. PMID: 16670652. <https://doi.org/10.1097/01.chi0000205699.58626.b5>.
- Mohr-Jensen C, Steinhausen H-C. 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. *Clin Psychol Rev*. 2016;48:32–42. <https://doi.org/10.1016/j.cpr.2016.05.002>.
- Rösler M, Retz W, Retz-Junginger P, Hengesch G, Schneider M, Supprian T, et al. (2004). Prevalence of attention deficit-/hyperactivity disorder (ADHD) and comorbid disorders in young male prison inmates. *Eur Arch Psychiatry Clin Neurosci*. 2004;254(6):365–71. <https://doi.org/10.1007/s00406-004-0516-z>.
- Einarsson E, Sigurdsson JF, Gudjonsson GH, Newton AK, Bragason OO. (2009). Screening for attention-deficit hyperactivity disorder and co-morbid mental disorders among prison inmates. *Nord J Psychiatry*. 2009;63(5):361–7. <https://doi.org/10.1080/08039480902759184>.
- Ginsberg Y, Hirvikoski T, Lindefors N. Attention deficit hyperactivity disorder (ADHD) among longer-term prison inmates is a prevalent, persistent and disabling disorder. *BMC Psychiatry*. 2010;10:112. <https://doi.org/10.1186/1471-244X-10-112>.
- Usher AM, Stewart LA, Wilton G. Attention deficit hyperactivity disorder in a Canadian prison population. *Int J Law Psychiatry*. 2013;36(3–4):311–5. <https://doi.org/10.1016/j.jljp.2013.04.005>.
- Knecht C, de Alvaro R, Martinez-Raga J, Balanza-Martinez V. Attention-deficit hyperactivity disorder (ADHD), substance use disorders, and criminality: a difficult problem with complex solutions. *Int J Adolesc Med Health*. 2015; 27(2):163–75. <https://doi.org/10.1515/ijamh-2015-5007>.
- Young S, Moss D, Sedgwick O, Fridman M, Hodgkins P. A meta-analysis of the prevalence of attention deficit hyperactivity disorder in incarcerated populations. *Psychol Med*. 2015;45(2):247–58. <https://doi.org/10.1017/S0033291714000762>.
- Baggio S, Fructuoso A, Guimaraes M, Fois E, Golay D, Heller P, et al. Prevalence of attention deficit hyperactivity disorder in detention settings: a systematic review and meta-analysis. *Front Psychiatry*. 2018;9:331. <https://doi.org/10.3389/fpsy.2018.00331>.
- Farooq R, Emerson LM, Keoghlan S, Adamou M. (2016). Prevalence of adult ADHD in an all-female prison unit. *ADHD Attention Deficit and Hyperactivity Disorders*. 2016;8(2):113–9. <https://doi.org/10.1007/s12402-015-0186-x>.
- Fayyad J, De Graaf R, Kessler R, Alonso J, Angermeyer M, Demyttenaere K, et al. Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *Br J Psychiatry*. 2007;190(5):402–9. <https://doi.org/10.1192/bjp.bp.106.034389>.
- Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, et al. The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *Am J Psychiatry*. 2006;163(4): 716–23. <https://doi.org/10.1176/ajp.2006.163.4.716>.
- Fletcher J, Wolfe B. Long-term consequences of childhood ADHD on criminal activities. *J Ment Health Policy Econ*. 2009;12(3):119–38.
- Barkley RA, Fischer A, Smallish L, Fletcher K. (2004) Young adult follow-up of hyperactive children: antisocial activities and drug use. *J Child Psychol Psychiatry*. 2004 Feb;45(2):195–211. <https://doi.org/10.1111/j.1469-7610.2004.00214.x>.
- Dalsgaard S, Mortensen PB, Frydenberg M, Thomsen PH. Long-term criminal outcome of children with attention deficit hyperactivity disorder. *Criminal Behavior Mental Health*. 2013;23(2):–98. <https://doi.org/10.1002/cbm.1860>.
- Silva D, Colvin L, Glauert R, Bower C. Contact with the juvenile justice system in children treated with stimulant medication for attention deficit hyperactivity disorder: a population study. *Lancet Psychiatry*. 2014;1(4):278–85. [https://doi.org/10.1016/S2215-0366\(14\)70302-5](https://doi.org/10.1016/S2215-0366(14)70302-5).
- Lichtenstein P, Hallndr L, Zetterqvist J, Sjölander A, Serlachius E, Fazel S, et al. Medication for attention deficit-hyperactivity disorder and criminality. *N Engl J Med*. 2012;367(21):2006–14. <https://doi.org/10.1056/NEJMoa1203241>.
- Retz W, Ginsberg Y, Turner D, Barra S, Retz-Junginger P, Larsson H, et al. Attention-Deficit/Hyperactivity Disorder (ADHD), antisociality and delinquent behavior over the lifespan. *Neurosci Biobehav Rev*. 2021:236–48. <https://doi.org/10.1016/j.neubiorev.2020.11.025>.
- Young S, Thome J. (2011) ADHD and offenders. *World J Biol Psychiatry*. 2011;12(Suppl 1):124–8. <https://doi.org/10.3109/15622975.2011.600319>.
- Young S, Wells J, Gudjonsson GH. Predictors of offending among prisoners: the role of attention-deficit hyperactivity disorder and substance use. *J Psychopharmacol*. 2011;25(11):1524–32. <https://doi.org/10.1177/026988110370502>.
- Mordre M, Groholt B, Kjelsberg E, Sandstad B, Myhre AM. The impact of ADHD and conduct disorder in childhood on adult delinquency: A 30 years follow-up study using official crime records. *BMC Psychiatry*. 2011;11:57. <https://doi.org/10.1186/1471-244X-11-57>.
- Unnever JD, Cornell DG. (2003). Bullying, self-control, and ADHD. *Journal of Interpersonal Violence*. 2003;18(2):129–47. <https://doi.org/10.1177/0886260502238731>.
- Du Rietz E, Kuja-Halkola R, Brikell I, Jangmo A, Sariaslan A, Lichtenstein P, et al. (2017). Predictive validity of parent-and self-rated ADHD symptoms in adolescence on adverse socioeconomic and health outcomes. *Eur Child Adolesc Psychiatry*. 2017;26(7):857–67. <https://doi.org/10.1007/s00787-017-0957-3>.
- Young S, Gudjonsson GH. (2006) ADHD symptomatology and its relationship with emotional, social and delinquency problems. *Psychol Crime Law*. 2006;12(5):463–71. <https://doi.org/10.1080/10683160500151183>.
- Gudjonsson GH, Sigurdsson JF, Sigfusdottir ID, Young S. A national epidemiological study of offending and its relationship with ADHD

- symptoms and associated risk factors. *J Atten Disord.* 2014;18(1):3–13. <https://doi.org/10.1177/1087054712437584>.
26. Shaw P, Stringaris A, Nigg J, Leibenluft E. Emotion dysregulation in attention deficit hyperactivity disorder. *Am J Psychiatry.* 2014;171(3):276–93. <https://doi.org/10.1176/appi.ajp.2013.13070966>.
 27. Stringaris A. Irritability in children and adolescents: a challenge for the DSM 5. *Eur Child Adolesc Psychiatry.* 2011;20:61–6. <https://doi.org/10.1007/s00787-010-0150-4>.
 28. Aldao A, Gee DG, De Los RA, Seager I. Emotion regulation as a transdiagnostic factor in the development of internalizing and externalizing psychopathology: Current and future directions. *Dev Psychopathol.* 2016; 28(4pt1):927–46. <https://doi.org/10.1017/S0954579416000638>.
 29. Shaw P, Stringaris A, Nigg J, Leibenluft E. Emotion dysregulation in attention deficit hyperactivity disorder. *Am J Psychiatr.* 2014;171(3):276–93. 24480998. <https://doi.org/10.1176/appi.ajp.2013.13070966>.
 30. Connor DF, Steeber J, McBurnett K. (2010) a review of attention- deficit/ hyperactivity disorder complicated by symptoms of oppositional defiant disorder or conduct disorder. *J Dev Behav Pediatr.* 2010;31(5):427–40. 2053 5081. <https://doi.org/10.1097/DBP.0b013e3181e121bd>.
 31. Landaas ET, Halmøy A, Oedegaard KJ, Fasmer OB, Haavik J. (2012). The impact of cyclothymic temperament in adult ADHD. *J Affect Disord.* 2012; 142(1–3):241–7. <https://doi.org/10.1016/j.jad.2012.04.034>.
 32. Barkley RA, Murphy KR, Robison RJ, Reimherr FW, Marchant BK, Kondo D, et al. Deficient emotional self-regulation in adults with attention deficit hyperactive disorder (ADHD): the relative contribution of emotional impulsiveness and ADHD symptoms to adaptive impairment in major life activities. *J ADHD Related Disorders.* 2010;1(4):5–28. <https://doi.org/10.521/adhd.2010.18.4.1>.
 33. Surman CB, Biederman J, Spencer T, Yorks D, Miller CA, Petty CR, et al. Deficient emotional self-regulation and adult attention deficit hyperactivity disorder: a family risk analysis. *Am J Psychiatry.* 2011;168(6):617–23. <https://doi.org/10.1176/appi.ajp.2010.10081172>.
 34. Surman CB, Biederman J, Spencer T, Miller CA, McDermott KM, Faraone SV. Understanding deficient emotional self-regulation in adults with attention deficit hyperactivity disorder: a controlled study. *Atten Defic Hyperact Disord.* 2013;5(3):273–81. <https://doi.org/10.1007/s12402-012-0100-8>.
 35. Retz W, Stieglitz RD, Corbisiero S, Retz-Junginger P, Rösler M. Emotional dysregulation in adult ADHD: what is the empirical evidence? *Expert Rev Neurother.* 2012;12(10):1241–51. <https://doi.org/10.1586/em.12.109>.
 36. Corbisiero S, Mörtstedt B, Bitto H, Stieglitz RD. Emotional Dysregulation in adults with attention-deficit/hyperactivity disorder—validity, predictability, severity, and comorbidity. *J Clin Psychol.* 2017;73(1):99–112. <https://doi.org/10.1002/jclp.22317>.
 37. Hirsch O, Chavanon M, Reichmann E, Christiansen H. Emotional dysregulation is a primary symptom in adult Attention-Deficit / Hyperactivity Disorder (ADHD). *J Affective Disorders.* 2018;232(2018):41–7. <https://doi.org/10.1016/j.jad.2018.02.007>.
 38. Garofalo C, Velotti P. Negative emotionality and aggression in violent offenders: the moderating role of emotion dysregulation. *J Crim Just.* 2017; 51:9–16. <https://doi.org/10.1016/j.jcrimjus.2017.05.015>.
 39. Aebi M, Barra S, Bessler C, Steinhilber HC, Walitza S, Plattner B. Oppositional defiant disorder dimensions and subtypes among detained male adolescent offenders. *J Child Psychol Psychiatry.* 2016;57(6):729–36. 26493948. <https://doi.org/10.1111/jcpp.12473>.
 40. Pardini DA, Fite PJ. Symptoms of conduct disorder, oppositional defiant disorder, attention-deficit/hyperactivity disorder, and callous-unemotional traits as unique predictors of psychosocial maladjustment in boys: advancing an evidence base for DSM-V. *J Am Acad Child Adolesc Psychiatry.* 2010;49(11):1134–44. 20970701. <https://doi.org/10.1016/j.jaac.2010.07.010>.
 41. APA, American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-5®); 2013. <https://doi.org/10.1176/appi.books.9780890425596.x00>.
 42. Kooij JJS, Francken MH. Diagnostic interview for ADHD in adults 2.0 (DIVA 2.0). Adult ADHD. 2010:33–99. https://doi.org/10.1007/978-1-4471-4138-9_3.
 43. Ramos-Quiroga JA, Nasillo V, Richarte V, Corrales M, Palma F, Ibáñez P, et al. Criteria and concurrent validity of DIVA 2.0: a semi-structured diagnostic interview for adult ADHD. *J Atten Disord.* 2019;23(10):1126–35. <https://doi.org/10.1177/1087054716646451>.
 44. Adler LA, Kessler RC, Spencer T. Adult ADHD self-report scale-v1.1 (ASRS-v1.1) symptom checklist. New York: World Health Organization; 2003.
 45. Kessler RC, Adler L, Ames M, Demler O, Faraone S, Hiripi EV, et al. The World Health Organization adult ADHD self-report scale (ASRS): a short screening scale for use in the general population. *Psychol Med.* 2005;35(2):245–56. <https://doi.org/10.1017/s0033291704002892>.
 46. Silverstein MJ, Alperin S, Faraone SV, Kessler RC, Adler LA. Test–retest reliability of the adult ADHD self-report scale (ASRS) v1.1 screener in non-ADHD controls from a primary care physician practice. *Family Pract.* 2017; 2017:cmx115. <https://doi.org/10.1093/fampra/cmz115>.
 47. Fredriksen M, Dahl AA, Martinsen EW, Klungsoyr O, Haavik J, Peleikis DE. Effectiveness of one-year pharmacological treatment of adult attention-deficit/hyperactivity disorder (ADHD): an open-label prospective study of time in treatment, dose, side-effects and comorbidity. *Eur Neuropsychopharmacol.* 2014;24:1873–84. <https://doi.org/10.1016/j.euroneuro.2014.09.013>.
 48. Dvir Y, Ford JD, Hill M, Frazier JA. Childhood maltreatment, emotional dysregulation, and psychiatric comorbidities. *Harvard Rev Psychiatry.* 2014; 22(3):149–61. <https://doi.org/10.1097/HRP.0000000000000014>.
 49. Ford JD, Courtois CA. Complex PTSD, affect dysregulation, and borderline personality disorder. *Borderline Personality Disorder and Emotion Dysregulation.* 2014;1(1):1–17. <https://doi.org/10.1186/2051-6673-1-9>.
 50. Fisher AC, Rushby JA, McDonald S, Parks N, Piguet O. Neurophysiological correlates of dysregulated emotional arousal in severe traumatic brain injury. *Clin Neurophysiol.* 2015;126(2):314–24. <https://doi.org/10.1016/j.clinph.2014.05.033>.
 51. Ismail Z, Gatchel J, Bateman DR, Barcelos-Ferreira R, Cantillon M, Jaeger J, et al. Affective and emotional dysregulation as pre-dementia risk markers: exploring the mild behavioral impairment symptoms of depression, anxiety, irritability, and euphoria. *Int Psychogeriatr.* 2018;30(2):185–96. <https://doi.org/10.1017/S1041610217001880>.
 52. Conners CK, Erhardt D, Epstein JN, Parker JDA, Sitarenios G, Sparrow E. Self-ratings of ADHD symptoms in adults I: factor structure and normative data. *J Atten Disord.* 1999;3(3):141–51. https://doi.org/10.1007/978-0-387-79948-3_1278.
 53. Barkley RA. Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychol Bull.* 1997;121(1): 65–94. <https://doi.org/10.1037/0033-2909.121.1.65>.
 54. Biederman J, Spencer TJ, Petty C, Hyder LL, O'Connor KB, Surman CBH, et al. Longitudinal course of deficient emotional self-regulation CBCL profile in youth with ADHD: prospective controlled study. *Neuropsychiatr Dis Treat.* 2012;8:267–76. <https://doi.org/10.2147/NDT.S29670>.
 55. Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, et al. The validity of the MINI international neuropsychiatric interview (MINI) according to the SCID-P and its reliability. *Eur Psychiatry.* 1997;12:232–41. [https://doi.org/10.1016/S0924-9338\(97\)83297-X](https://doi.org/10.1016/S0924-9338(97)83297-X).
 56. Sheehan DV, Lecrubier Y, Sheehan KH, et al. The Mini-international neuropsychiatric interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry.* 1998;59(Suppl 20):22–33. <https://doi.org/10.1037/t18597-000>.
 57. Rothman K, Greenland S. *Modern Epidemiology*. 2nd ed. Philadelphia: Lippincott-Raven; 1998. *Epidemiology*, Vol. 9, No. 3 (May, 1998). p. 333–7.
 58. Gilthorpe MS, Jiang T, Tilling K, Ellison GT, Baxter PD. Common Statistical Errors: Over-Adjustment for Confounders and Mediators in Lifecourse Research. *Int J Epidemiol.* 2015;44(suppl_1):i36–7. <https://doi.org/10.1093/ije/dyv097.126>.
 59. Schisterman EF, Cole SR, Platt RW. Overadjustment bias and unnecessary adjustment in epidemiologic studies. *Epidemiology.* 2009;20(4):488–95. <https://doi.org/10.1097/EDE.0b013e3181a819a1>.
 60. Anker E, Haavik J, Heir T. Alcohol and drug use disorders in adult attention-deficit/hyperactivity disorder: prevalence and associations with attention-deficit/hyperactivity disorder symptom severity and emotional dysregulation. *World J Psychiatry.* 2020;10(9) 0000-0000 URL: <https://www.wjgnet.com/2220-3206/full/v10/i9/0000.htm>. <https://doi.org/10.5498/wjv.v10.i9.0000>.
 61. Eisenberg N, Spinrad TL, Eggum ND. Emotion-related self-regulation and its relation to children's maladjustment. *Annu Rev Clin Psychol.* 2010;6(1):495–525. <https://doi.org/10.1146/annurev.clinpsy.121208.131208>.
 62. Dowden C, Brown SL. The role of substance abuse factors in predicting recidivism: a meta-analysis. *Psychol Crime Law.* 2002;8(3):243–64. <https://doi.org/10.1080/10683160208401818>.
 63. IBM Corp. (2013). IBM SPSS statistics for windows, version 22.0. Armonk: IBM Corp. DOI: <https://doi.org/10.4135/9781526435439>.
 64. Skardhamar T. Lifetime conviction risk—a synthetic cohort approach. *J Scand Stud Criminol Crime Prev.* 2014;15(1):96–101. <https://doi.org/10.1080/14043858.2014.883175>.

65. Dalsgaard S, Mortensen PB, Frydenberg M, Thomsen PH. ADHD, stimulant treatment in childhood and subsequent substance abuse in adulthood—a naturalistic long-term follow-up study. *Addict Behav.* 2014;39(1):325–8. <https://doi.org/10.1016/j.addbeh.2013.09.002>.
66. Walker JT, Maddan S. Understanding statistics for the social sciences, criminal justice, and criminology. Jones & Bartlett Publishers; 2016. p. 99. ISBN 1449634036. Retrieved August 7, 2016
67. Gudjonsson GH, Sigurdsson JF, Adalsteinsson TF, Young S. The relationship between ADHD symptoms, mood instability, and self-reported offending. *J Atten Disord.* 2013;17(4):339–46. <https://doi.org/10.1177/1087054711429791>.
68. Gudjonsson GH, Sigurdsson JF, Sigfusdottir ID, Asgeirsdottir BB, González RA, Young S. A national epidemiological study investigating risk factors for police interrogation and false confession among juveniles and young persons. *Soc Psychiatry Psychiatr Epidemiol.* 2016;51(3):359–67. [26537245. https://doi.org/10.1007/s00127-015-1145-8](https://doi.org/10.1007/s00127-015-1145-8).
69. Gudjonsson GH, Gonzalez R, Young S. The risk of making a false confession: the role of developmental disorders, conduct disorder, psychiatric symptoms, and compliance. *J Atten Disord.* 2019;25(5):715–23. <https://doi.org/10.1177/1087054719833169>.
70. González RA, Gudjonsson GH, Wells J, Young S. The role of emotional distress and ADHD on institutional behavioral disturbance and recidivism among offenders. *J Attention Disorder.* 2016;20:368–78. <https://doi.org/10.1177/1087054713493322>.
71. Storebø OJ, Rasmussen PD, Simonsen E. Association between insecure attachment and ADHD: environmental mediating factors. *J Attention Disorders.* 2016;20(2):187–96. <https://doi.org/10.1177/1087054713501079>.
72. Pingault J-B, Côté SM, Lacourse E, Galéra C, Vitaro F, Tremblay RE. Childhood Hyperactivity, Physical Aggression and Criminality: A 19-Year Prospective Population-Based Study. *PLoS.* 2013;8(5):e62594 PMID: 23658752. <https://doi.org/10.1371/journal.pone.0062594>.
73. Donfrancesco R, Di Trani M, Porfirio MC, Giana G, Miano S, Andriola E. Might the temperament be a bias in clinical study on attention-deficit hyperactivity disorder (ADHD)?: novelty seeking dimension as a core feature of ADHD. *Psychiatry Res.* 2015;227(2–3):333–8. <https://doi.org/10.1016/j.psychres.2015.02.014>.
74. Mann FD, Engelhardt L, Briley DA, Grotzinger AD, Patterson MW, Tackett JL, et al. Sensation seeking and impulsive traits as personality endophenotypes for antisocial behavior: evidence from two independent samples. *Personal Individ Differ.* 2017;105:30–9. <https://doi.org/10.1016/j.paid.2016.09.018>.
75. Young S. In: Fitzgerald M, Bellgrove M, Gill M, editors. Forensic aspects of ADHD. Handbook of attention deficit hyperactivity disorder. Chichester: Wiley; 2007. p. 91–108.
76. Bell CC. DSM-IV: diagnostic and statistical manual of mental disorders. *Jama.* 1994;272(10):828–9. <https://doi.org/10.1001/jama.1994.03520100096046>.
77. Barkley RA, Fischer M. The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. *J Am Acad Child Adolesc Psychiatry.* 2010;49(5):503–13. <https://doi.org/10.1097/00004583-201005000-00011>.
78. Faraone SV, Rostain AL, Blader J, Busch B, Childress AC, Connor DF, et al. Practitioner Review: Emotional dysregulation in attention-deficit/hyperactivity disorder – implications for clinical recognition and intervention. *J Child Psychol Psychiatry.* 2018, 2018. PMID: 29624671. <https://doi.org/10.1111/jcpp.12899> Practitioner Review: Emotional dysregulation in attention-deficit/hyperactivity disorder - implications for clinical recognition and intervention.
79. Musser ED, Galloway-Long HS, Frick PJ, Nigg JT. Emotion regulation and heterogeneity in attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry.* 2013;52(2):163–171.e2. <https://doi.org/10.1016/j.jaac.2012.11.009>.
80. Krueger RF, Schmutte PS, Caspi A, Moffitt TE, Campbell K, Silva PA. Personality traits are linked to crime among men and women: evidence from a birth cohort. *J Abnorm Psychol.* 1994;103(2):328–38. <https://doi.org/10.1037/0021-843X.103.2.328>.
81. Reimherr FW, Roesler M, Marchant BK, Gift TE, Retz W, Philipp-Wiegmann F, et al. Types of adult attention-deficit/hyperactivity disorder: a replication analysis. *J Clin Psychiatry.* 2020;81(2):0–0. <https://doi.org/10.4088/JCP.19m13077>.
82. Ebejer JL, Medland SE, van der Werf J, Gondro C, Henders AK, Lynskey M, et al. Attention Deficit Hyperactivity Disorder in Australian Adults: Prevalence, Persistence, Conduct Problems and Disadvantage. *Plos one.* 2012;7(10):e47404. <https://doi.org/10.1371/journal.pone.0047404>.
83. Küpper T, Haavik J, Drexler H, Ramos-Quiroga JA, Wermelskirchen D, Prutz C, et al. The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. *Int Archiv Occup Environ Health.* 2012;85(8):837–47. <https://doi.org/10.1007/s00420-012-0794-0>.
84. Barkley RA, Fischer M, Smallish L, MAK F. Young Adult Outcome of Hyperactive Children: Adaptive Functioning in Major Life Activities. *J Am Acad Child Adolesc Psychiatry.* 2006;45(2):192–202. <https://doi.org/10.1097/01.chi.0000189134.97436.e2>.
85. Von Polier GG, Vloet TD, Herpertz-Dahlmann B (2012). ADHD and delinquency – a developmental perspective. *Behav Sci Law.* 2012;30(2):121–39. <https://doi.org/10.1002/bsl.2005>.
86. Crunelle CL, Van Den Brink W, Moggi F, Konstenius M, Franck J, Levin FR, et al. (2018) international consensus statement on screening, diagnosis and treatment of substance use disorder patients with comorbid attention deficit/hyperactivity disorder. *Eur Addict Res.* 2018;24(1):43–51. <https://doi.org/10.1159/000487767>.
87. Nohr EA, Olsen J. Commentary: Epidemiologists have debated representativeness for more than 40 years—has the time come to move on? *Int J Epidemiol.* 2013;42(4):1016–7. <https://doi.org/10.1093/ije/dyt102>.
88. Rothman KJ, Gallacher JEJ, Hatch EE. Why representativeness should be avoided. *Int J Epidemiol.* 2013;42:1012–4. <https://doi.org/10.1093/ije/dys223>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions





Verbal working memory and processing speed: Correlations with the severity of attention deficit and emotional dysregulation in adult ADHD

Espen Anker*¹ , Geir Ogrim^{2,3}  and Trond Heir⁴ 

¹Oslo ADHD Clinic, Norway

²Østfold Hospital Trust, Norway

³Gillberg Neuropsychiatry Centre, University of Gothenburg, Sweden

⁴Institute of clinical Medicine, University of Oslo, Norway

Objectives. The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), emphasizes symptoms severity with regard to the diagnosis of attention deficit hyperactivity disorder (ADHD). Many clinicians use neuropsychological test results as objective measures of cognitive functions as part of the diagnostic work-up. The aim of this study was to investigate whether the psychometric test results regarding verbal working memory and processing speed are useful as indicators of the severity of attention deficits and emotional dysregulation in adults with ADHD.

Methods. This observational cross-sectional clinical study included 418 adults diagnosed with ADHD according to the DSM-5. Attention deficit severity was defined based on the inattentive subscale of the Adult ADHD Self-Report Scale. Emotional dysregulation was assessed with the Deficient Emotional Self-Regulation scale. Verbal working memory was measured with the Working Memory Index (WMI), and processing speed was measured with the Processing Speed Index (PSI) from the Wechsler Adult Intelligence Scale, third edition.

Results. The full-scale intelligence quotients of the participants were in the normal range, with expected reductions in verbal working memory and processing speed. Only processing speed was associated with attention deficits ($\beta = -.056$, $p = .003$). The association between the psychometric test result for verbal working memory and processing speed and that between the severity of attention deficits and emotional dysregulation were weak ($R^2 < .1$) and mostly non-significant.

Conclusion. The psychometric index scores for verbal working memory (WMI) and processing speed (PSI) seem to have limited utility as indicators of the severity of attention deficits and emotional dysregulation in adult ADHD patients.

When assessing attention deficit hyperactivity disorder (ADHD), clinicians often use results from neuropsychological tests to obtain objective measures of the patient's cognitive function to supplement clinical assessments that are based on subjective self-

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

*Correspondence should be addressed to Espen Anker, Oslo ADHD Clinic, Kirkeveien 64B, 0366 Oslo, Norway (email: espen.anker@online.no).

report questionnaires and interviews. There are several reasons for this. The symptoms constituting ADHD are extreme variants of normal behaviours, and the boundary between normality and pathology is based on clinical judgement. Several studies have shown that the diagnosis of ADHD is highly dependent on the source of the report, thus underscoring the need for objective assessments (Barkley, Fischer, Smallish, & Fletcher, 2002). In addition, some symptoms of ADHD may reflect the presence of other disorders. Clinical difficulties related to attention deficits have been confirmed in several studies involving adults with ADHD (Barkley, 2010a; Bush, 2010; Hallelund, Haavik, & Lundervold, 2012; Seidman, 2006), and they have been reported in studies assessing the severity of nine Diagnostic and Statistical Manual of Mental Disorders (DSM)-defined inattentive symptoms, for example those reflected in the Adult ADHD Self-Report Scale (ASRS) inattentive subscore (Fredriksen et al., 2014; Kessler et al., 2005; Silverstein et al., 2019). Adults with ADHD also have impaired executive functioning (Silverstein et al., 2020), but they do not necessarily exhibit attention deficits on psychometric tests (Fabio & Caprì, 2017).

Emotional dysregulation, which is recognized as a transdiagnostic factor (Aldao, Gee, De Los, & Seager, 2016), is a common feature in ADHD even though it is not part of the criteria for the disorder (Barkley, 2010b; Barkley & Fischer, 2010; Connor, Steeber, & McBurnett, 2010; Hirsch, Chavanon, Reichmann, & Christiansen, 2018; Landaas, Halmøy, Oedegaard, Fasmer, & Haavik, 2012; Retz, Stieglitz, Corbisiero, Retz-Junginger, & Rösler, 2012; Shaw, Stringaris, Nigg, & Leibenluft, 2014; Surman et al., 2011, 2013). The clinical expression of emotional dysregulation is observable as excessive and inappropriate emotional expressions, irritability, and outbursts of temper (Shaw et al., 2014; Stringaris, 2011). This impulsivity with regard to anger is an important and disabling feature associated with ADHD (Bunford, Evans, & Langberg, 2018; Skirrow & Asherson, 2013). There is a strong relationship between anger and cognitive distortions (Chereji, Pintea, & David, 2012), and frequencies of both the expression of anger and cognitive distortion have been found to be associated with impaired executive functioning (Persampiere, Poole, & Murphy, 2014). Psychometric testing for executive functioning is frequently used in the neuropsychiatric assessment of ADHD, and one core executive function is verbal working memory, which involves the mental retention of auditory information that enables future action (Diamond, 2013). In several studies, a close relationship was found between emotional regulation and the level of working memory (Barkley, 1997; Jasielska et al., 2015; Jensen et al., 2018; Lima, Peckham, & Johnson, 2018; Rutherford, Booth, Crowley, & Mayes, 2016). Emotional dysregulation has not yet been conclusively defined, and there are several ways to measure, interpret, and categorize emotional dysregulation. In our study, emotional dysregulation was assessed based on eight relevant items (see Table 5) from the larger Current Behaviour Scale–Self-Report, known as the Deficient Emotional Self-Regulation (DESR) questionnaire (Barkley, 1997, 2010a; Biederman et al., 2012; Surman et al., 2013). The concept of emotional dysregulation has different aspects, involving both strong emotional responses and the impaired regulation of emotions.

Working memory is an important executive function (Diamond, 2013), and working memory deficits are well documented in adults with ADHD (Alderson, Kasper, Hudec, & Patros, 2013). Psychometric tests of working memory can be used to differentiate between those with and without ADHD in both children and adults (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2015). According to Allan Baddeley, working memory consists of a central executive and two content/modality-specific components: a phonological loop that handles verbal content and a visuospatial sketchpad that handles spatial content

(Baddeley & Logie, 1999). Attention deficits/attention control is strongly related to central executive function. In addition, attention deficits in ADHD seem to have a stronger relation to the visuospatial component than to the phonological loop (Faraone & Biederman, 2005; Nigg et al., 2005; Woods, Lovejoy, & Ball, 2002). Different theoretical models have been developed to attempt to gain insight into working memory deficits in ADHD (Barkley, 1997; Diamond, 2005; Rapport, Chung, Shore, & Isaacs, 2001). In our sample, we analysed whether verbal working memory was correlated with the severity of either attention deficits or emotional dysregulation in ADHD.

Psychometric tests of processing speed measure the efficiency of cognitive executive skills, and impairments revealed by such tests have been linked to reports of attention deficits in children with ADHD (Kibby, Vadnais, & Jagger-Rickels, 2019; Thorsen, Meza, Hinshaw, & Lundervold, 2018) and adults with ADHD (Tucha et al., 2017). Impaired processing speed explains to a large extent the impairment in executive functions (Butzbach et al., 2019). Impaired processing speed is linked to inattentive behaviour in children with ADHD (Kubo et al., 2018), and slow processing speed predicts social functioning in ADHD patients with inattention (Thorsen et al., 2018). It seems that slower processing speed and attention deficit coexist and are important predictors of academic achievement (Mayes & Calhoun, 2007). Studies have shown that the WAIS test results can be used to adequately discriminate between adults with and without ADHD, although the intragroup heterogeneity is substantial (Frazier, Demaree, & Youngstrom, 2004; Thaler, Bello, & Etcoff, 2013; Theiling & Petermann, 2014; Woods et al., 2002). Measures of working memory and processing speed can be used to discriminate adequately between ADHD and control groups (Nikolas, Marshall, & Hoelzle, 2019). Deficits in verbal working memory have been reported to be associated with parent-rated emotional dysregulation in children with ADHD (Bunford et al., 2018), but others have not found this association in adults with ADHD (Chereji et al., 2012; Skirrow & Asherson, 2013). In our sample, we measured the correlations between processing speed and the severity of attention deficits and emotional dysregulation in adult ADHD patients. The severity of the symptoms of ADHD is emphasized in the DSM-5 (American Psychiatric Association, 2013), but whether the WAIS test scores are useful as an indicator of the severity of attention deficits and emotional dysregulation is unknown.

We hypothesize that verbal working memory and processing speed are correlated with the severity of attention deficits and emotional dysregulation, even after controlling for covariates. The covariates that may affect the associations between neurocognitive test results and the clinical features of ADHD include age (Ardila, 2007), sex (Rucklidge & Tannock, 2001), education level (Reitan & Wolfson, 1995), and depression (Gorlyn et al., 2006).

The aim of this study was to determine whether the WAIS test results for verbal working memory and processing speed are useful as indicators of the severity of (1) attention deficits and (2) emotional dysregulation in adults with ADHD.

To broaden our understanding of the topic, we also sought to determine whether each item on the attention deficit and emotional dysregulation scales was correlated with the psychometric test results for verbal working memory and processing speed.

Material and methods

This was an observational cross-sectional clinical study.

Participants

The study sample consisted of 418 adults aged 18–65 years who fulfilled the criteria for a diagnosis of attention deficit hyperactivity disorder (ADHD) according to the DSM, Fifth Edition (DSM-5; American Psychiatric Association, 2013). They were referred to a private psychiatric outpatient clinic in Oslo, Norway, that specializes in psychiatric examination, assessment, and treatment of adults with ADHD.

Recruitment was conducted between 2014 and 2018. All patients participating in the study were assessed by a psychiatrist with the semi-structured Diagnostic Interview for ADHD in Adults, second edition (DIVA 2.0; Kooij & Francken, 2010). The DIVA 2.0 is a reliable tool for assessing and diagnosing adult ADHD (Ramos-Quiroga et al., 2019). A clinical diagnosis of ADHD was made according to DSM-5 (American Psychiatric Association, 2013). From 2014 to 2018, 418 of the assessed patients fulfilled the diagnostic criteria for ADHD and were invited to participate in the study. Sixty-five per cent of them were self-referred, and thirty-five per cent had been referred by health care practitioners. All 418 patients (100%) gave their written consent to participate and were included in the study. In accordance with the diagnostic criteria, all participants had ADHD symptoms before the age of 12. At the time of inclusion in study, they had severe ADHD symptoms that resulted in marked impairments in social or occupational functioning. There were no exclusion criteria. None of the participants were under the influence of stimulant medications, alcohol, or other drugs during the clinical assessment or administration of the WAIS test. Comorbid disorders were assessed using the Mini-International Neuropsychiatric Interview (MINI).

The study was approved by the Regional Medical Ethics Committee, South-East Norway 2015/426. Assessments and the handling of data were carried out in accordance with the relevant ethics standards and the principles of the Declaration of Helsinki.

Measures

The age of the participants was recorded in years at the time of enrolment. Sex was recorded as female (scored as 0) or male (scored as 1) based on patient self-report. The following sociodemographic information was collected. Marriage or cohabitation was scored as 1, and all other statuses were scored as 0. If the participant was living with children of whom they had at least partial custody, a score of 1 was recorded; otherwise, even if they had no children, or children who lived somewhere else, a score of 0 was recorded. Education level was categorized by the number of years of education as follows: 12 years or fewer was scored as 1, 13–15 years was scored as 2, and more than 15 years was scored as 3. Employment was defined as ‘yes’ and scored as 1 if that employment was reported as the main source of income; otherwise, it was scored as 0.

The level of depression was measured by the Montgomery–Åsberg depression rating scale (MADRS), with all ten items summarized as a total score ranging from 0 to 60 (Montgomery & Åsberg, 1979). The MADRS is a reliable and valid screening instrument for the evaluation of depression (Davidson, Turnbull, Strickland, Miller, & Graves, 1986).

ADHD symptom severity was measured using the Adult ADHD Self-Report Scale (ASRS) Symptom Check List, v1.1 produced by the World Health Organization (World Health Organization, 2003). The ASRS is a reliable and valid screening instrument for the evaluation of ADHD in adults (Fredriksen et al., 2014; Kessler et al., 2005; Silverstein et al., 2019). The ASRS questionnaire is composed of 9 attention deficit items (items 1–4 and 7–11) and 9 hyperactive-impulsive items (items 5, 6, and 12–18; Fredriksen et al., 2014).

Response options for each item range from 0 to 4. The items were marked by the participant as never (0), rarely (1), sometimes (2), often (3), and very often (4). This yielded a total attention deficit score ranging from 0 to 36 (see Table 4).

Emotional dysregulation was assessed with a questionnaire containing eight items from the 99 items on the Current Behaviour Scale–Self-Report (CBS-SR) questionnaire, known as the DESR scale (Barkley, 1997, 2010b; Barkley & Fischer, 2010; Biederman et al., 2008; Surman et al., 2013). The eight items were as follows: 1: Quick to get angry or become upset; 2: Easily frustrated; 3: Overreact emotionally; 4: Easily excited by activities going on around me; 5: Lose my temper; 6: Argue with others; 7: Am touchy or easily annoyed by others; and 8: Am angry or resentful. The eight items are described in Table 5, and their response options range from 0 to 3. The items were marked by the participant as never or rarely (0), sometimes (1), often (2), and very often (3). This yielded a total ED score ranging from 0 to 24 (see Table 5).

Verbal working memory was assessed by the Working Memory Index (WMI; tests of Arithmetic, Digit Span and Letter-Number Sequencing), and processing speed was assessed with the Processing Speed Index (PSI; tests of Digit Symbol-Coding, Symbol Search) from the Wechsler Adult Intelligence Scale, 3rd edition (WAIS-III). (Evers et al., 2012; Kaufman, 1999; Wechsler, 1997; Wechsler, Nyman, & Nordvik, 2003) The test scores included in the statistical analyses were the age-corrected scale scores.

Procedure

The data were collected during routine assessments performed by a psychiatrist in an outpatient clinic. Psychometric testing was completed by a special education teacher with experience and expertise in ADHD and the use of the WAIS-III.

After the assessment, the patients were asked if they approved the use of their clinical information in an anonymous form in the statistical analyses for this clinical trial.

Statistical analysis

Frequencies with per cent proportions are reported for all categorical variables and means with standard deviations are reported for continuous descriptive variables. We performed chi-square tests or *t*-tests to compare sociodemographic characteristics between females and males. All tests were two-tailed, and differences were considered significant if $p < .05$. Continuity correction was performed, and Asymp. Sig. (2-sided) was recorded. *t* Tests were used to compare continuous variables between females and males.

We used linear regression analyses to examine associations between measures of self-reported attention deficit (the ASRS subscore), or self-reported emotional dysregulation (the DESR scale) as the dependent/outcome variables, and sociodemographic variables, the MADRS score, the Working Memory Index (WMI) and the Processing Speed Index (PSI) as the independent variables. The test scores from the WAIS-III included in the statistical analyses were the age-corrected scale scores. We used Cronbach's alpha to assess the internal consistency and reliability of the eight items from the DESR scale. Cronbach's alpha for the eight scale items in our sample was .86, indicating high internal consistency.

Given our two hypotheses, we used the Bonferroni correction and considered differences significant if p was $< .025$. For all association tests, beta ratios with 95% confidence intervals were calculated as the measurement of the effect size. To measure the explained variance, we used the R^2 -squared value. If the R^2 value was $< .30$, the effect

was considered weak. If the R^2 value was between .30 and .50, the effect was considered moderate. If the R^2 value was $>.50$, the effect was considered strong (Moore, Notz, & Notz, 2006).

We used Pearson correlation analyses to examine the associations of each of the nine attention deficit items on the ASRS and each of the eight emotional dysregulation items on the DESR scale with the Working Memory Index (WMI) and the Processing Speed Index (PSI).

There were no missing data. All statistical analyses were performed using IBM SPSS version 22 (IBM, 2013).

Results

Table 1 shows the demographics, depression severity (as the MADRS score), attention deficit ASRS subscale score, hyperactive-impulsive ASRS subscale score, total WAIS score, and four WAIS subindex scores in the females ($n = 188$) and males ($n = 230$) in this study. More females than males lived with children. A total of 61.7% of the participants reported employment as their main source of income, and nearly 51.4% reported that they had received more than 12 years of education. The frequencies of psychiatric comorbidities in this sample were 12.9% for depressive disorders, 31.8% for anxiety disorders, and 13.6% for substance use disorders.

The mean hyperactive-impulsive score (SD), mean attention deficit score (SD), and mean emotional dysregulation score (SD) are reported. Females in our sample scored higher on all three measures. The table also shows the WAIS profile of our sample. The mean full-scale intelligence quotient (FSIQ) in our sample was 103.2 ($SD: 13.8$), and females had an average FSIQ of 101.3, while men had an average FSIQ of 104.8. Both sexes had typical profiles with significantly reduced scores on the Working Memory Index (WMI) and Processing Speed Index (PSI) compared to those expected based on their FSIQ. Significant correlations ($p < .001$) were found between all four subindex scores on the WAIS (data not shown).

The severity of attention deficits, as reflected in the ASRS attention deficit subscale score, was significantly correlated only with the PSI (Pearson correlation $-.16$, $p < .001$).

The severity of hyperactivity and impulsivity, as measured by the ASRS hyperactivity-impulsivity subscale, was significantly correlated with the FSIQ (Pearson correlation $-.19$, $p < .001$) and all four subindex scores but was not associated with any of the independent variables in the adjusted model (data not shown).

The severity of emotional dysregulation, as measured by the DESR scale score, was significantly correlated with the FSIQ (Pearson correlation $-.23$, $p < .001$) and with all four subindex scores.

Table 2 shows the linear regression model of the associations between the outcome/dependent variable attention deficit severity, as measured by the ASRS inattention subscore, and the independent variables of age, sex, education level, depression, the WMI, and the PSI. The PSI ($\beta = -.056$, CI -0.094 to -0.017 , $p = .005$) but not the WMI ($\beta = -.012$, CI: -0.049 to 0.025 , $p = .52$) was associated with attention deficits. The R square (explained variance) for the fully adjusted model was .026, that is the model explained only 2.6% of the variance in attention deficits in our sample. None of the covariates were significantly associated.

Table 3 shows the linear regression model of the associations between the severity of emotional dysregulation, as measured by the DESR scale, as the outcome/dependent

Table 1. Demographic characteristics, depression (MADRS score), ASRS scores measuring attention deficits and hyperactivity-impulsivity separately, emotional dysregulation measured by the Deficient Emotional Self-Regulation (DESR) scale and WAIS scores with four subindex scores, in 418 adult patients diagnosed with ADHD in a psychiatric outpatient clinic specializing in the examination and treatment of ADHD

	All (<i>n</i> = 418)	Male (<i>n</i> = 230)	Female (<i>n</i> = 188)
Age range	18–69	18–67	18–69
Age: mean (<i>SD</i>)	36.6 (11.5)	36.1 (11.8)	37.2 (11.1)
Education years (%)			
≤12	203 (48.6)	122 (53.0)	81 (43.1)
13–15	179 (42.8)	92 (40.0)	87 (48.6)
>15	36 (8.6)	16 (7.0)	20 (10.6)
Married/cohabiting	188 (45.0)	105 (45.7)	83 (44.1)
Living with children	178 (42.6)	86 (37.4)	92 (48.9)*
Employment	258 (61.7)	149 (64.8)	109 (58.0)*
Depression-MADRS score, mean (<i>SD</i>)	12.4 (6.4)	12.4 (6.9)	12.4 (5.7)
Comorbidity			
Depressive disorders (%)	54 (12.9)	28 (12.2)	26 (13.8)
Anxiety disorders (%)	133 (31.8)	58 (25.2)	75 (39.9)**
Substance use disorders (%)	57 (13.6)	36 (15.7)	21 (11.2)
ASRS: Attention deficit score, mean (<i>SD</i>)	27.3 (4.4)	26.9 (4.4)	27.8 (4.2)*
ASRS: Hyperactivity-impulsivity score, mean (<i>SD</i>)	23.8 (6.5)	23.1 (6.7)	24.6 (6.3)*
Emotional dysregulation score, mean (<i>SD</i>)	12.1 (5.5)	11.0 (5.6)	13.4 (5.0)***
WAIS total score: FSIQ			
Mean (<i>SD</i>)	103.2 (13.8)	104.8 (13.5)	101.3 (14.0)**
Range	66–151	71–151	66–145
Verbal Comprehension Index			
Mean (<i>SD</i>)	105.9 (12.7)	107.2 (12.6)	104.2 (12.7)**
Range	74–161	82–150	74–145
Perceptual Organizational Index			
Mean (<i>SD</i>)	110.5 (16.0)	111.6 (15.8)	109.2 (16.2)
Range	70–150	70–150	72–148
Working Memory Index (WMI)			
Mean (<i>SD</i>)	90.5 (13.1)	92.3 (12.3)	88.2 (13.1)**
Range	57–136	65–136	57–126
Processing Speed Index (PSI)			
Mean (<i>SD</i>)	88.1 (12.5)	88.3 (12.7)	87.2 (12.3)
Range	57–125	60–125	57–120

Note. Numbers (percentage) or means (standard deviation) are reported. Sexes are compared with the chi-squared test or *t*-test.

p* < .05.; *p* < .01.; ****p* < .001. (Females compared with males.)

variable and the independent variables of age, sex, education level, depression, the WMI and the PSI. Neither the WMI ($\beta = -.05$, CI: -0.095 to -0.002 , $p = .041$) nor the PSI ($\beta = -.03$, CI: -0.08 to -0.13 , $p = .22$) were associated with the severity of emotional dysregulation in the adjusted model after the Bonferroni correction, with significance based on $p < .025$. Depression was associated with the severity of emotional dysregulation ($\beta = .13$, 95% CI: 0.05 – 0.21 , $p = .002$). The *R*-squared value (explained variance) for the fully adjusted model was .098, that is the model explained only 9.8% of the variance

Table 2. Associations between attention deficits measured by the ASRS inattention subscore as an outcome/dependent variable and age, sex, education level, depression measured by the MADRS score, Working Memory Index (WMI) and Processing Speed Index (PSI) as independent variables in a clinical sample of 418 adult ADHD patients. Linear regression

	Unadjusted				Adjusted			
	B	95% CI	p-Value	R ²	B	95% CI	p-Value	R ²
Age	.002	-0.039 to 0.034	.910	-.002	-.003	-0.039 to 0.034	.882	.026
Sex (male vs. female)	-.922	-1.76 to -0.082	.031	.009	-.781	-1.635 to 0.073	.073	
Education (3 level)	.164	-0.49 to 0.82	.621	-.002	.520	-0.188 to 1.229	.150	
Depression (MADRS score)	.003	-0.063 to 0.069	.929	-.002	-.001	-0.067 to 0.064	.965	
Working Memory Index	-.035	-0.067 to 0.003	.033	.009	-.012	-0.049 to 0.025	.524	
Processing Speed Index	-.054	-0.087 to -0.021	.002	.021	-.056	-0.094 to -0.017	.005	

Table 3. Associations between emotional dysregulation measured by the Deficient Emotional Self-Regulation (DESR) scale as an outcome/dependent variable and age, sex, education level, depression (MADRS score), Working Memory Index (WMI) and Processing Speed Index (PSI) as independent variables in a clinical sample of 418 adult ADHD patients. Linear regression

	Unadjusted/crude			Adjusted			R ²
	B	95% CI	p-Value	B	95% CI	p-Value	
Age	.018	-0.03 to 0.06	.43	.021	-0.02 to 0.066	.35	.098
Sex (male vs. female)	-2.36	-3.40 to -1.32	<.001	-2.13	-3.18 to -1.09	<.001	
Education (3 level)	-.61	-1.44 to 0.22	.15	-.16	-1.03 to 0.71	.72	
Depression (MADRS score)	.14	0.06 to 0.23	.001	.13	0.05 to 0.21	.002	
Working Memory Index	-.08	-0.12 to -0.040	<.001	-.05	-0.095 to -0.002	.041	
Processing Speed Index	-.058	-0.10 to -0.016	.007	-.03	-0.08 to -0.13	.22	

in emotional dysregulation in our sample. Age and education level did not contribute to the explained variance, but being female was significantly associated with emotional dysregulation ($\beta = -2.13$, 95% CI: -3.18 to -1.09 , $p < .001$), and depression was also significantly associated with emotional dysregulation ($\beta = .13$, 95% CI: 0.05 – 0.21 , $p = .002$).

Table 4 shows the nine attention deficit items in the DSM-5 ADHD criteria and the nine corresponding inattentive items on the ASRS, the Pearson correlations with the WMI and PSI and the significance (2-tailed). Four items pertaining to attention deficits were correlated with the WMI (ASRS items 1, 3, 7, and 9), and four items were correlated with the PSI (ASRS items 2, 3, 9, and 11). Three items were correlated with neither (ASRS items 4, 8, and 10).

Table 5 shows the eight items pertaining to emotional dysregulation composing the Deficient Emotional Self-Regulation (DESR) scale, the Pearson correlations with the WMI and the PSI and the significance (2-tailed). All but one item (DESR item 4: Easily excited by activities going on around me) were correlated with both the WMI and PSI.

Discussion

The main finding in this study was that the correlations between the psychometric tests of verbal working memory and processing speed and the severity of attention deficits and emotional dysregulation were weak ($R^2 < .1$) and mostly not significant. Only processing speed was associated with the severity of attention deficits ($\beta = -.056$, $p = .003$). The psychometric WAIS test index scores for verbal working memory (WMI) and processing speed (PSI) seem to have limited utility as indicators of the severity of inattention and emotional dysregulation in adults with ADHD.

In our sample, 51.4% of the patients had attained a university degree or graduate degree, which is higher than the proportion of the general Norwegian population (34.6%; <https://www.ssb.no/en/utdanning/statistikker/utniv>). Participants in our sample had a 61.7% employment rate, which is lower than the 70.3% in the general population (<https://www.ssb.no/en/arbeid-og-lonn/statistikker/aku>).

In our sample, we found a mean FSIQ of 103.1 (Table 1), which is just above the general population mean, indicating good cognitive function. This finding is contrary to previous studies that have shown ADHD patients as a group to have lower FSIQ scores than the population-based norms (Bridgett & Walker, 2006), primarily due to reduced scores on the WMI and PSI (Harrison, DeLisle, & Parker, 2008; Iverson, Lange, Viljoen, & Brink, 2006; Theiling & Petermann, 2014; Wechsler, Coalson, & Raiford, 2008). There has been a minor discussion regarding whether adults with ADHD perform differently from normal controls on the FSIQ (Faraone & Biederman, 2005; Nigg et al., 2005), but our findings confirmed a normal FSIQ mean score and range, at least in this sample.

We found significant reductions in the WMI and PSI scores compared to the FSIQ scores for both sexes (Table 1), which is in line with the findings reported in the literature (Harrison et al., 2008; Iverson et al., 2006; Theiling & Petermann, 2014; Wechsler et al., 2008).

In our sample, verbal working memory was not associated with the severity of attention deficits in the adjusted model. This is in line with other studies, which found only weak correlations between working memory scores and self-reports in individuals with ADHD (Barkley & Murphy, 2011). Self-reported symptom severity measures in adult ADHD patients usually do not correlate with the objective psychometric performance

Table 4. DSM-5 ADHD criteria: nine items pertaining to attention deficits, the corresponding nine ASRS inattentive items and their correlations with the Working Memory Index (WMI) and Processing Speed Index (PSI) in a clinical sample of 418 adult patients with ADHD

DSM-5: attention deficit items	ASRS Inattentive items	Working Memory Index (WMI)		Processing Speed Index (PSI)	
		Person correlation	Sign. (p)	Pearson correlation	Sign. (p)
a. Often fails to pay close attention to details or makes careless mistakes in schoolwork, at work or during other activities	1. How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?	.120	.014	-.002	.964
b. Often has difficulty sustaining attention in tasks or play activities	8. How often do you have difficulty keeping your attention when you are doing boring or repetitive work?	-.031	.527	-.020	.678
c. Often does not seem to listen when spoken to directly	9. How often do you have difficulty concentrating on what people say to you, even when they are speaking to you directly?	-.221	<.001	-.106	.030
d. Often does not follow through instructions and fails to finish schoolwork, chores, or duties in workplace	7. How often do you make careless mistakes when you have to work on a boring or difficult project?	-.141	.004	-.066	.177
e. Often has difficulty organizing tasks and activities	2. How often do you have difficulty getting things in order when you have to do a task that requires organization?	.009	.862	-.166	.001
		.004	.939	-.087	.077

Continued

Table 4. (Continued)

DSM-5: attention deficit items	ASRS Inattentive items	Working Memory Index (WMI)		Processing Speed Index (PSI)	
		Person correlation	Sign. (<i>p</i>)	Pearson correlation	Sign. (<i>p</i>)
f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort	4. When you have a task that requires a lot of thought, how often do you avoid or delay getting started?	-.036	.458	-.054	.267
g. Often loses things necessary for tasks and activities	10. How often do you misplace or have difficulty finding things at home or at work?	-.068	.162	-.099	.043
h. Is often easily distracted by extraneous stimuli	11. How often are you distracted by activity or noise around you?	-.098	.044	-.141	.004
i. Is often forgetful in daily activities	3. How often do you have problems remembering appointments or obligations?				

Note. Pearson correlations with significance (2-tailed) for each item are shown.

Table 5. Emotional dysregulation was measured as Deficient Emotional Self-Regulation (DESR) scale items and correlated with the working memory index (WMI) and processing speed index (PSI) in a clinical sample of 418 adult patients with ADHD

Deficient Emotional Self-Regulation (DESR) items:	Working Memory Index (WMI)		Processing Speed Index (PSI)	
	Pearson correlation	Significance (<i>p</i>)	Pearson correlation	Significance (<i>p</i>)
1: Quick to get angry or become upset	-.188	<.001	-.112	.022
2: Easily frustrated	-.157	.001	-.126	.010
3: Overreact emotionally	-.139	<.001	-.145	.003
4: Easily excited by activities going on around me	-.015	.762	.057	.245
5: Lose my temper	-.209	<.001	-.111	.024
6: Argue with others	-.116	.018	-.142	.004
7: Am touchy or easily annoyed by others	-.113	.022	-.136	.006
8: Am angry or resentful	-.145	.003	-.101	.039

Note. Pearson correlations with significance (2-tailed) for each item are shown.

tests (Woods et al., 2002) and correlate only weakly with WAIS performance (Theiling, Petermann, & Daseking, 2013). Others have found that ADHD symptom severity correlated significantly with working memory (Alderson et al., 2013; Brydges, Ozolnieks, & Roberts, 2017), but the correlations between working memory tests and self-reported rating scales were weak and mostly not significant (Barkley & Murphy, 2011). All these findings indicate that the importance of working memory deficits in ADHD is consistent and persists into adulthood and that methodological variability may explain why working memory deficits have not been uniformly detected (Alderson et al., 2013; Kasper, Alderson, & Hudec, 2012).

According to Baddeley's definition of working memory, there are two modality-specific components, namely a phonological loop (verbal working memory) and a visuospatial sketchpad (Baddeley et al., 1999). Earlier research has found attention deficits in ADHD to be more closely tied to the visuospatial component than to the phonological loop (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; Rapport et al., 2008; Rhodes, Park, Seth, & Coghill, 2012).

In our sample, the severity of attention deficits was not associated with verbal working memory (the phonological loop), as measured by the WMI, after adjusting for other covariates (Table 2). This is in line with previous studies that found that measures of attention deficits in ADHD are unrelated to verbal working memory (Martinussen et al., 2005); however, other studies found that verbal working memory is an important domain of cognitive dysfunction in ADHD (Ramos, Hamdan, & Machado, 2019).

In our sample, the WMI correlated with four out of nine inattentive items on the ASRS (see Table 4), which underscores the fact that the WMI captures only a part of the attention deficits in ADHD, namely, the 'verbal working memory deficit'. Verbal working memory is commonly viewed as the temporary maintenance of verbal information and is an immediate form of memory used to transform verbal information, such as speech, into meaning (Caplan & Waters, 1999). A person with impaired verbal working memory might experience the following: 'I hear what you say, but I don't understand what you

mean'. A specific question to assess this would be: *Do you often have difficulties understanding what people say? Do you often misinterpret what other people say? Do you often have difficulties interpreting the meaning of a sentence spoken to you? Do other people often comment that you have not understood their verbal intention or sentence?* These questions would enable us to better understand specific parts of the clinical difficulties involved in a verbal working memory deficit, and these suggested questions are slightly different from the four verbal attention deficit items in the DSM (See Table 4. ASRS item 1, 3, 7, 9).

In our sample, the severity of attention deficits was associated with decreased scores for processing speed, such as the PSI (see Table 2). This is in line with other studies in adults with ADHD (Barkley & Murphy, 2011; Schweiger, Abramovitch, Doniger, & Simon, 2007; Shanahan et al., 2006). An impaired PSI has been found to correlate with inattention in children with ADHD (Kubo et al., 2018; Thaler et al., 2013; Yang et al., 2013). Severe attention deficits in children correlate with an impaired PSI (Jacobson, Geist, & Mahone, 2018). Our finding is in line with other studies that have shown that adults with ADHD have significant reductions in processing speed, as reflected in low PSI scores on the WAIS-IV (Wechsler et al., 2008). Other studies have not found that processing speed is associated with ADHD symptom severity (Brydges et al., 2017). Impaired processing speed has been reported to be weakly correlated with self-reported attention deficit ratings given by individuals with ADHD (Barkley & Murphy, 2011).

In our sample, the PSI correlated with four out of nine items pertaining to attention deficits (ASRS scores for attention deficit, Table 4), which underscores that the PSI captures only a part of attention deficits in ADHD, namely the 'processing speed deficit'. Processing speed is the pace at which you take in information, make sense of it, and begin to respond (Horning & Davis, 2012). In our sample, we found that the mean processing speed was significantly reduced compared to the mean FSIQ score. Questions that could solicit information about processing speed would be as follows: *How often do you have difficulties starting boring tasks you should have done? How often is it difficult to stay on the right track for your boring tasks? How often do you miss meeting the goal of your boring tasks?* These questions are also slightly different from the four original DSM items that correlated significantly with processing speed (see Table 4: ASRS items 2, 3, 9, 11).

In our study, emotional dysregulation was not associated with verbal working memory or the WMI score after adjusting for covariates (see Table 3). This is in contrast to a previous study that found that deficits in verbal working memory were associated with the severity of parent-rated emotional dysregulation in children with ADHD (Uderman, 2015); however, other studies have not found this association in adults with ADHD (Gisbert et al., 2019; Surman et al., 2015). In our sample, both depression and female sex were significantly associated with emotional dysregulation and may to some extents have affected the adjusted regression analysis. Additionally, applying the Bonferroni correction and considering differences significant if $p < .025$ favoured a non-significant result. In an unadjusted model, emotional dysregulation was associated with both the WMI ($B = -.08$, 95% CI: -0.12 to -0.040 , $p < .001$, $R^2 = .035$) and PSI ($B = -.058$, 95% CI: -0.10 to -0.016 , $p = .007$, $R^2 = .017$). There were correlations between emotional dysregulation and verbal working memory and processing speed, but the causal relations were difficult to assess.

Verbal working memory impairment has long been recognized as an important domain of cognitive dysfunction in ADHD (Moore et al., 2006), and since verbal working memory tasks typically involve the ability to recall language perception and production (Acheson & MacDonald, 2009), decreased scores for verbal working memory may reflect impulsive

and aggressive verbal behaviour (Kockler & Stanford, 2008). Our finding underscores these earlier findings that aggression, as defined in emotional dysregulation, is linked to verbal working memory deficits.

Decreased executive function has long been linked to physical aggression in boys (Séguin, Pihl, Harden, Tremblay, & Boulerice, 1995), and poor verbal working memory storage in children may be associated with greater peer rejection (McQuade, Murray-Close, Shoulberg, & Hoza, 2013). The association between higher levels of aggression and decreased levels of verbal working memory has also been seen in studies in the general adult population (Colby, 2008), and this may provide a new goal for verbal working memory training, that is, a reduction in emotional dysregulation. People with low verbal working memory capacity compared with their FSIQ score may not comprehend all relevant arguments in a verbal discussion and may therefore misunderstand, misinterpret, or misjudge more easily. Misunderstanding is a main source of anger (Lochman, Barry, Powell, & Young, 2010). If so, this may encourage clinicians to try verbal working memory training as an additional therapeutic approach to achieve better emotional regulation in ADHD patients, although anger regulation and other aspects of emotional dysregulation should still be treated directly.

In our sample, the emotional dysregulation items on the DESR scale correlated with both verbal working memory and processing speed, with correlations observed for seven out of the eight items on the DESR scale (see Table 5). The relationship between anger and cognitive distortions (Chereji et al., 2012) and the frequencies of both the expression of anger and cognitive distortion have been linked to decreased executive functioning (Persampiere et al., 2014). Explosive anger, labelled emotional dysregulation, has been understood as a distortion and a disabling feature of ADHD (Bunford et al., 2018; Skirrow & Asherson, 2013).

Methodological considerations

In this paper, we assumed that the participants reported their true beliefs regarding their subjective dysfunction. This clinical report from the patient is the basis for the diagnosis of ADHD, and in our paper, for the measurements of the severity of attention deficits and emotional dysregulation. Patients may, however, underreport or exaggerate their difficulties. What is considered to be the reference state of normality may also differ. In our paper, we considered what the patient reported to be fact, even though it was a subjective truth.

Psychometric tests are more objective. However, the results may not reflect everyday functioning. It is possible that some patients score well in a controlled, optimized test situation but are more impaired in their everyday life. This may result in clients reporting severe attention deficits in everyday life without having impaired test scores. When these differences between subjective reports and objective test results occur, they are not necessarily conflicting but may rather complement each other.

The sex differences we see in Table 1 reflect the participants in our sample. There is a selection bias given that the two sexes may seek help at different levels of impairment, and therefore, we cannot generalize sex differences in our sample to the general ADHD population.

Despite the performance of extensive psychological, biological, and neuroscientific studies, it has not been possible to establish a general unified agreement on the categorization of working memory; therefore, several working memory tasks are used in working memory studies (such as the Sternberg task, n-back task, Corsi block-tapping test,

Wechsler's Memory Scale, and working memory subtests of the WAIS; Chai, Abd Hamid, & Abdullah, 2018). Barkley suggested that working memory is one out of four executive functions that is impaired in ADHD (Barkley, 1997) and that this could be assessed by a questionnaire such as the Behaviour Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). Even though the WAIS is the most frequently used psychometric test among clinical neuropsychologists (Rabin, Paolillo, & Barr, 2016) and there is a consensus that the WAIS measures working memory to some extent (Hill et al., 2010), it has certain limitations with regard to measuring working memory. There are three reasons to be wary of using the WAIS WMI to measure working memory:

The first reason is that the WMI only measures verbal and not visuospatial working memory, so the question is whether the WMI measures not the true 'working memory' of a person but rather their verbal understanding and education (Chai et al., 2018). The tests are only auditory. Tests of visual working memory that could have completed the picture are lacking (Egeland, 2015; Egeland, Bosnes, & Johansen, 2008). However, according to Baddeley (Baddeley & Hitch, 2001; Baddeley et al., 1974), the most important part of working memory is the central executive function, which is thought to not be modality-specific.

The second reason is that the WMI includes an arithmetic task that also correlates with verbal comprehension tests because linguistically formulated assignments place substantial demands on verbal understanding (Arnau & Thompson, 2000). The correlation between arithmetic and language tests may also be due to a third variable. Good linguistic and technical accounting skills are particularly affected by education, and calculation tasks can hardly be considered working memory tests (Egeland et al., 2008).

The third reason is that reduced scores on the WMI are not specific for ADHD but are sensitive for nearly all psychiatric disorders, while the PSI is more specific for ADHD (Egeland et al., 2009; Theiling et al., 2013). Others have explained this based on the fact that WMI impairment may be related to symptom severity in general psychopathology (Brydges et al., 2017).

In our sample, we had a wide range of FSIQ estimates. It is possible that participants with a very high FSIQ will experience severe problems even when they have a moderate index score of WMI or PSI within the normal range. Adjustments for this were not performed in this paper.

Strengths and limitations

The strengths of the study include a naturalistic design with the inclusion of a large number of participants referred for the examination and treatment of ADHD. They were recruited from a large area and over a long period of time. There were no exclusion criteria, and everyone who met the ADHD criteria was asked to participate in the study. The rate of consent and the number of participants were high.

The inclusion of patients attending a private and not a governmentally funded ADHD clinic questions the representativeness of the study sample with regard to the adult population with ADHD in general. The participants may have a higher socioeconomic status and be less impaired than those attending public outpatient clinics or hospitals. Additionally, the prevalence of comorbidities may not be representative of those in the total ADHD patient population. However, we assume that differences in the sample selection may primarily affect the mean scores and, to a lesser extent, the associations between the mean scores (Nohr & Olsen, 2013; Rothman, Gallacher, & Hatch, 2013). The

associations between WAIS scores and ADHD or emotional dysregulation severity should therefore be considered in a more general context.

The use of the WAIS-III and not the newer WAIS-IV is a weakness of this study. The WAIS-IV provides superior measurement, scoring, and structural models to measure the FSIQ than the WAIS-III (And & Benson, 2013), but working memory is still tested only in the auditory modality (Egeland, 2015). Both the WAIS-III and WAIS-IV detect reductions in working memory and processing speed in adults with ADHD, which suggests that the identification of such deficits with both versions of the WAIS remains robust (Wechsler et al., 2008). Altogether, the WAIS-IV is better and newer but not a radically different assessment instrument than the WAIS-III. We therefore believe the statistical results and the results reported in this article would not have been radically different if the WAIS-IV had been used.

Clinical implications

The symptoms of attention deficits in ADHD are related to the subjective experience of being inattentive and are associated with the objective finding of processing speed deficits. Emotional dysregulation is a subjective awareness of experiencing explosive anger but was not associated with verbal working memory (WMI) or processing speed (PSI) as measured by the WAIS test.

In our adult ADHD sample, we found typical reductions in the WMI and PSI, but only the PSI was associated with attention deficits, and the power of this association was limited. It seems that objectively tested verbal working memory and processing speed measure only parts of the subjective experience of attention deficits and emotional dysregulation.

Extending the WAIS test battery by including measures of visuospatial working memory could make this psychometric tool more suitable for measuring attention deficits in ADHD.

Weak correlations between items of attention deficit (ASRS subscore) and emotional dysregulation (DESR) indicate that the questions on these questionnaires do not fully reflect verbal working memory and processing speed. Alternative questions, as suggested in the paper, may better reflect these parameters.

Conclusions

The participants in our adult ADHD sample had normal mean FSIQ score, with the expected typical reduction in verbal working memory, as reflected on the WMI, and processing speed, as reflected on the PSI. Only processing speed was associated with the severity of attention deficits, but the effect size of the association was small. Our results indicate that the correlations between the severity of attention deficits and emotional dysregulation and psychometric tests of verbal working memory and processing speed were weak ($R^2 < .1$) and mostly not significant. The psychometric WAIS WMI and PSI seem to have limited utility as indicators of the severity of attention deficits and emotional dysregulation in adult ADHD patients.

Acknowledgements

We want to thank Cia Bjercke for performing WAIS-III tests.

Conflicts of interest

EA has received speaker honoraria from Shire, TH and GO report no conflicts of interest.

Authors' contributions

EA and TH designed the study. EA collected and analysed the data. EA and TH actively participated in the writing of the manuscript and all authors approved the final draft. GØ commented on the manuscript draft and suggested changes.

Ethical approval and consent to participate

The study was approved by the Regional Medical Ethics Committee, South-East D, Norway, 2015/426. Written consent to participate was obtained from all participants.

Consent for publication

Not applicable.

Declarations

We confirm that all methods were performed in accordance with relevant guidelines and regulations.

Data availability statement

Data are from a private psychiatric outpatient clinic in Oslo. Public availability would compromise privacy of the respondents. According to the approval from the Norwegian Regional committees for medical and health research ethics, the data are to be stored properly and in line with the Norwegian Law of privacy protection. However, anonymized data are freely available to interested researchers upon request, pending ethical approval from the ethics committee. Interested researchers can contact project leader Espen Anker (espen.anker@online.no) with requests for the data.

References

- Acheson, D. J., & MacDonald, M. C. (2009). Verbal working memory and language production: Common approaches to the serial ordering of verbal information. *Psychological Bulletin*, *135*(1), 50. <https://doi.org/10.1037/a0014411>
- Aldao, A., Gee, D. G., De Los, R. A., & Seager, I. (2016). Emotion regulation as a transdiagnostic factor in the development of internalizing and externalizing psychopathology: Current and future directions. *Development and Psychopathology*, *28*(4pt1), 927–946. <https://doi.org/10.1017/S0954579416000638>
- 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. <https://doi.org/10.1037/a0032371>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing. Text Revision. Washington DC.

- And, T. G. E., & Benson, N. (2013). Matters of consequence: An empirical investigation of the WAIS-III and WAIS-IV and implications for addressing the Atkins intelligence criterion. *Journal of Forensic Psychology Practice*, 2013(13), 27–48. <https://doi.org/10.1080/15228932.2013.746913>
- Ardila, A. (2007). Normal aging increases cognitive heterogeneity: Analysis of dispersion in WAIS-III scores across age. *Archives of Clinical Neuropsychology*, 22, 1003–1011. <https://doi.org/10.1016/j.acn.2007.08.004>
- Arnau, R., & Thompson, B. (2000). Second-order confirmatory factor analysis of the WAIS-III. Wechsler Adult Intelligence Scale. *Assessment*, 7, 237–246. <https://doi.org/10.1177/107319110000700304>
- Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. H. Bower (Ed.), *Psychology of learning and motivation* (Vol. 8, pp. 47–89). New York, NY: Academic Press.
- Baddeley, A., & Hitch, G. (2001). In A. Miyake (Ed.), *Working memory in perspective* (pp. 240–260). East Sussex, UK: Psychology Press.
- Baddeley, A. D., & Logie, R. H. (1999). Working memory: A multiple-component model. In A. Miyake, & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28–61). Cambridge, UK: Cambridge University Press. <http://dx.doi.org/10.1080/14640749208401281>
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121, 65–94. <https://doi.org/10.1037/0033-2909.121.1.65>
- Barkley, R. A. (2010a). Deficient emotional self-regulation is a core component of ADHD. *Journal of ADHD & Related Disorders*, 1, 5–37.
- Barkley, R. A. (2010b). Differential diagnosis of adults with ADHD. *The Journal of Clinical Psychiatry*, 71(07), e17. <https://doi.org/10.4088/JCP.9066tx1c>
- Barkley, R. A., & Fischer, M. (2010). The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. *Journal of the American Academy of Child and Adolescent Psychiatry*, 49, 503–513. <https://doi.org/10.1016/j.jaac.2010.01.019>
- Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2002). The persistence of attention-deficit/hyperactivity disorder into young adulthood as a function of reporting source and definition of disorder. *Journal of Abnormal Psychology*, 111(2), 279. <https://doi.org/10.1037/0021-843X.111.2.279>
- 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 performance on EF tests. *Journal of Psychopathological Behavior Assessment*, 2011, 33. <https://doi.org/10.1007/s10862-011-9217-x>
- Biederman, J., Petty, C. R., Fried, R., Black, S., Faneuil, A., Doyle, A. E., . . . Faraone, S. V. (2008). Discordance between psychometric testing and questionnaire-based definitions of executive function deficits in individuals with ADHD. *Journal of Attention Disorders*, 12(1), 92–102. <https://doi.org/10.1177/1087054707305111>
- Biederman, J., Spencer, T. J., Petty, C., Hyder, L. L., O'Connor, K. B., Surman, C. B., & Faraone, S. V. (2012). Longitudinal course of deficient emotional self-regulation CBCL profile in youth with ADHD: Prospective controlled study. *Neuropsychiatric Disease and Treatment*, 8, 267. <https://doi.org/10.2147/NDT.S29670>
- Bridgett, D. J., & Walker, M. E. (2006). Intellectual functioning in adults with ADHD: A meta-analytic examination of full scale IQ differences between adults with and without ADHD. *Psychological Assessment*, 18(1), 1–14. <https://doi.org/10.1037/1040-3590.18.1.1>
- Brydges, C. R., Ozolnieks, K. L., & Roberts, G. (2017). Working memory—not processing speed—mediates fluid intelligence deficits associated with attention deficit/hyperactivity disorder symptoms. *Journal of Neuropsychology*, 11(3), 362–377. <https://doi.org/10.1111/jnp.12096>

- Bunford, N., Evans, S. W., & Langberg, J. M. (2018). Emotion dysregulation is associated with social impairment among young adolescents with ADHD. *Journal of Attention Disorders*, *22*(1), 66–82. <https://doi.org/10.1177/1087054714527793>
- Bush, G. (2010). Attention-deficit/hyperactivity disorder and attention networks. *Neuropsychopharmacology*, *35*(1), 278–300. <https://doi.org/10.1038/npp.2009.120>
- Butzbach, M., Fuermaier, A. B., Aschenbrenner, S., Weisbrod, M., Tucha, L., & Tucha, O. (2019). Basic processes as foundations of cognitive impairment in adult ADHD. *Journal of Neural Transmission*, *126*, 1347–1362. <https://doi.org/10.1007/s00702-019-02049-1>
- Caplan, D., & Waters, G. S. (1999). Verbal working memory and sentence comprehension. *Behavioral and Brain Sciences*, *22*(1), 77–94. <https://doi.org/10.1017/S0140525X99001788>
- Chai, W. J., Abd Hamid, A. I., & Abdullah, J. M. (2018). Working memory from the psychological and neurosciences perspectives: a review. *Frontiers in Psychology*, *9*, 401. <https://doi.org/10.3389/fpsyg.2018.00401>
- Chereji, S. V., Pinte, S., & David, D. (2012). The relationship of anger and cognitive distortions with violence in violent offenders' population: A meta-analytic review. *European Journal of Psychology Applied to Legal Context*, *4*(1), 59–77.
- Colby, M. (2008). Verbal and working memory deficits in an impulsive aggressive college sample (Doctoral dissertation). Baylor University.
- Connor, D. F., Steeber, J., & McBurnett, K. (2010). A review of attention-deficit/hyperactivity disorder complicated by symptoms of oppositional defiant disorder or conduct disorder. *Journal of Developmental & Behavioral Pediatrics*, *31*, 427–440. <https://doi.org/10.1097/DBP.0b013e3181e121bd>
- Davidson, J., Turnbull, C. D., Strickland, R., Miller, R., & Graves, K. (1986). The Montgomery-Åsberg Depression Scale: Reliability and validity. *Acta Psychiatrica Scandinavica*, *73*, 544–548. <https://doi.org/10.1111/j.1600-0447.1986.tb02723.x>
- Diamond, A. (2005). Attention-deficit disorder (attention-deficit/ hyperactivity disorder without hyperactivity): A neurobiologically and behaviorally distinct disorder from attention-deficit/ hyperactivity disorder (with hyperactivity). *Development and Psychopathology*, *17*, 807–825. <https://doi.org/10.1017/S0954579405050388>
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*(1), 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>
- Egeland, J. (2015). Measuring working memory with digit span and the letter-number sequencing subtests from the WAIS-IV: Too low manipulation load and risk for underestimating modality effects. *Applied Neuropsychology: Adult*, *22*, 445–451. <https://doi.org/10.1080/23279095.2014.992069>
- Egeland, J., Bosnes, O., & Johansen, H. (2008). Factor structure of the Norwegian version of the WAIS-III in a clinical sample the arithmetic problem. *Assessment*, *16*(3), 292–300. <https://doi.org/10.1177/1073191108324464>
- Egeland, J., Bosnes, O., & Johansen, H. (2009). Analysis of the Norwegian WAIS-III in a clinical sample. *Tidsskrift for Norsk Psykologforening*, *46*, 658–666.
- Evers, A., Muniz, J., Bartram, D., Boben, D., Egeland, J., FernandezHermida, J. R., . . . Urbánek, T. (2012). Testing practices in the 21st century: Developments and European psychologists' opinions. *European Psychologist*, *17*, 300–319. <https://doi.org/10.1027/1016-9040/a000102>
- Fabio, R. A., & Capri, T. (2017). The executive functions in a sample of Italian adults with ADHD: Attention, response inhibition and planning /organization. *Mediterranean Journal of Clinical Psychology*, *5*(3). <https://doi.org/10.6092/2282-1619/2017.5.1636>
- Faraone, S. V., & Biederman, J. (2005). What is the prevalence of adult ADHD? Results of a population screen of 966 adults. *Journal of Attention Disorders*, *9*, 384–391. <https://doi.org/10.1177/1087054705281478>
- Frazier, T. W., Demaree, H. A., & Youngstrom, E. A. (2004). Meta-analysis of intellectual and neuropsychological test performance in attention-deficit/hyperactivity disorder. *Neuropsychology*, *18*, 543–555. <https://doi.org/10.1037/0894-4105.18.3.543>

- Fredriksen, M., Dahl, A. A., Martinsen, E. W., Klungsøyr, O., Haavik, J., & Peleikis, D. E. (2014). Effectiveness of one-year pharmacological treatment of adult attention-deficit/hyperactivity disorder (ADHD): An open-label prospective study of time in treatment, dose, side-effects and comorbidity. *European Neuropsychopharmacology*, *24*, 1873–1884. <https://doi.org/10.1016/j.euroneuro.2014.09.013>
- Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). *Behavior rating inventory of executive function: BRIEF*. Odessa, FL: Psychological Assessment Resources.
- Gisbert, L., Richarte, V., Corrales, M., Ibáñez, P., Bosch, R., Bellina, M., Ramos-Quiroga, J. A. (2019). The relationship between neuropsychological deficits and emotional lability in adults with ADHD. *Journal of Attention Disorders*, *23*, 1514–1525. <https://doi.org/10.1177/1087054718780323>
- Gorlyn, M., Keilp, J. G., Oquendo, M. A., Burke, A. K., Sackeim, H. A., & Mann, J. (2006). The WAIS-III and major depression: Absence of VIQ/PIQ differences. *Journal of Clinical and Experimental Neuropsychology*, *28*, 1145–1157. <https://doi.org/10.1080/13803390500246944>
- Halleland, H. B., Haavik, J., & Lundervold, A. J. (2012). Set-shifting in adults with ADHD. *Journal of the International Neuropsychological Society*, *18*, 728–737. <https://doi.org/10.1017/S1355617712000355>
- Harrison, A. G., DeLisle, M. M., & Parker, K. C. H. (2008). An investigation of the General Abilities Index in a group of diagnostically mixed patients. *Journal of Psychoeducational Assessment*, *26*, 247–259. <https://doi.org/10.1177/0734282907304032>
- Hill, B., Elliott, E., Shelton, J., Pella, R., O’Jile, J., & Gouvier, W. (2010). Can we improve the clinical assessment of working memory? An evaluation of the WAIS-III using a working memory criterion construct. *Journal of Clinical and Experimental Neuropsychology*, *32*, 315. <https://doi.org/10.1080/13803390903032529>
- Hirsch, O., Chavanon, M., Reichmann, E., & Christiansen, H. (2018). Emotional dysregulation is a primary symptom in adult Attention-Deficit/Hyperactivity Disorder (ADHD). *Journal of Affective Disorders*, *232*, 41–47. <https://doi.org/10.1016/j.jad.2018.02.007>
- Horning, S., & Davis, H. P. (2012). *Aging and cognition in Encyclopedia of human behavior* (2nd ed., pp. 44–52). London: Academic Press. <https://doi.org/10.1016/B978-0-12-375000-6.00007-0>
- IBM. (2013). *SPSS statistics for windows, Version 22.0*. Armonk, NY: Author. Released 2013.
- Iverson, G. L., Lange, R. T., Viljoen, H., & Brink, J. (2006). WAIS-III General Ability Index in neuropsychiatry and forensic psychiatry inpatient samples. *Archives of Clinical Neuropsychology*, *21*, 77–82. <https://doi.org/10.1016/j.acn.2005.07.007>
- Jacobson, L. A., Geist, M., & Mahone, E. M. (2018). Sluggish cognitive tempo, processing speed, and internalizing symptoms: The moderating effect of age. *Journal of Abnormal Child Psychology*, *46*(1), 127–135. <https://doi.org/10.1007/s10802-017-0281-x>
- Jasielska, A., Kaczmarek, L., Brońska, A., Dominiak, M., Niemier, K., Patalas, D., . . . Tomczak, M. (2015). The relationship between working memory and emotion regulation strategies. *Roczniki Psychologiczne*, *18*, 567–578. <https://doi.org/10.18290/rpsych.2015.18.4-4en>
- Jensen, D. A., Høvik, M. F., Monsen, N. J. N., Eggen, T. H., Eichele, H., Adolfsdottir, S., . . . Sørensen, L. (2018). Keeping emotions in mind: The influence of working memory capacity on parent-reported symptoms of emotional lability in a sample of children with and without ADHD. *Frontiers in Psychology*, *9*, 1846. <https://doi.org/10.3389/fpsyg.2018.01846>
- Kasper, L. J., Alderson, R. M., & Hudec, K. L. (2012). MODERATORS of working memory deficits in children with attention-deficit/hyperactivity disorder (ADHD): A meta-analytic review. *Clinical Psychology Review*, *32*, 605–617. <https://doi.org/10.1016/j.cpr.2012.07.001>
- Kaufman, A. S. (1999). The essentials of WAIS-III assessment. *Essentials of psychological assessment series*.
- Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E. V., . . . Ustun, T. B. (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, <https://doi.org/10.1017/s0033291704002892>

- Kibby, M. Y., Vadnais, S. A., & Jagger-Rickels, A. C. (2019). Which components of processing speed are affected in ADHD subtypes? *Child Neuropsychology*, *25*, 964–979. <https://doi.org/10.1080/09297049.2018.1556625>
- Kockler, T. R., & Stanford, M. S. (2008). Using a clinically aggressive sample to examine the association between impulsivity, executive functioning, and verbal learning and memory. *Archives of Clinical Neuropsychology*, *23*(2), 165–173. <https://doi.org/10.1016/j.acn.2007.10.006>
- 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, 33–99.
- Kubo, Y., Kanazawa, T., Kawabata, Y., Tanaka, K., Okayama, T., Fujita, M., . . . Yoneda, H. (2018). Comparative analysis of the WISC between two ADHD subgroups. *Psychiatry Investigation*, *15*(2), 172. <https://doi.org/10.30773/pi.2017.07.12>
- Landaas, E. T., Halmøy, A., Oedegaard, K. J., Fasmer, O. B., & Haavik, J. (2012). The impact of cyclothymic temperament in adult ADHD. *Journal of Affective Disorders*, *142*(1–3), 241–247. <https://doi.org/10.1016/j.jad.2012.04.034>
- Lima, I. M., Peckham, A. D., & Johnson, S. L. (2018). Cognitive deficits in bipolar disorders: Implications for emotion. *Clinical Psychology Review*, *59*, 126–136. <https://doi.org/10.1016/j.cpr.2017.11.006>
- Lochman, J. E., Barry, T., Powell, N., & Young, L. (2010). Anger and aggression. In *Practitioner's guide to empirically based measures of social skills* (pp. 155–166). New York, NY: Springer. https://doi.org/10.1007/978-1-4419-0609-0_10
- Martinussen, R., Hayden, J., Hogg-Johnson, S., & Tannock, R. (2005). A meta-analysis of working memory impairments in children with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *44*, 377–384. <https://doi.org/10.1097/01.chi.0000153228.72591.73>
- Mayes, S. D., & Calhoun, S. L. (2007). Learning, attention, writing, and processing speed in typical children and children with ADHD, autism, anxiety, depression, and oppositional-defiant disorder. *Child Neuropsychology*, *13*, 469–493. <https://doi.org/10.1080/09297040601112773>
- McQuade, J. D., Murray-Close, D., Shoulberg, E. K., & Hoza, B. (2013). Working memory and social functioning in children. *Journal of Experimental Child Psychology*, *115*, 422–435. <https://doi.org/10.1016/j.jecp.2013.03.002>
- Montgomery, S. A., & Åsberg, M. (1979). A new depression scale designed to be sensitive to change. *British Journal of Psychiatry*, *134*, 382–389. <https://doi.org/10.1192/bjp.134.4.382>
- Moore, D. S., Notz, W. I., & Notz, W. (2006). *Statistics: Concepts and controversies*. New York, NY: Macmillan.
- Nigg, J. T., Stavro, G., Ettenhofer, M., Hambrick, D. Z., Miller, T., & Henderson, J. M. (2005). Executive functions and ADHD in adults: Evidence for selective effects on ADHD symptom domains. *Journal of Abnormal Psychology*, *114*, 706–717. <https://doi.org/10.1037/0021-843X.114.3.706>
- Nikolas, M. A., Marshall, P., & Hoelzle, J. B. (2019). The role of neurocognitive tests in the assessment of adult attention-deficit/hyperactivity disorder. *Psychological Assessment*, *31*, 685–698. <https://doi.org/10.1037/pas0000688>
- Nohr, E. A., & Olsen, J. (2013). Commentary: Epidemiologists have debated representativeness for more than 40 years—Has the time come to move on?. *International Journal of Epidemiology*, *42*, 1016–1017. <https://doi.org/10.1093/ije/dyt102>
- Persampiere, J., Poole, G., & Murphy, C. M. (2014). Neuropsychological correlates of anger, hostility, and relationship-relevant distortions in thinking among partner violent men. *Journal of Family Violence*, *29*, 625–641. <https://doi.org/10.1007/s10896-014-9614-5>
- Rabin, L. A., Paolillo, E., & Barr, W. B. (2016). Stability in test-usage practices of clinical neuropsychologists in the United States and Canada over a 10-year period: A follow-up survey of INS and NAN members. *Archives of Clinical Neuropsychology*, *31*(3), 206–230. <https://doi.org/10.1093/arclin/acw007>

- Ramos, A. A., Hamdan, A. C., & Machado, L. (2019). A meta-analysis on verbal working memory in children and adolescents with ADHD. *Clinical Neuropsychologist*, *2019*, 1–26. <https://doi.org/10.1080/13854046.2019.1604998>
- Ramos-Quiroga, J. A., Nasillo, V., Richarte, V., Corrales, M., Palma, F., Ibáñez, P., Kooij, J. S. (2019). Criteria and concurrent validity of DIVA 2.0: A semi-structured diagnostic interview for adult ADHD. *Journal of Attention Disorders*, *23*, 1126–1135. <https://doi.org/10.1177/1087054716646451>
- Rapport, M. D., Alderson, R. M., Kofler, M. J., Sarver, D. E., Bolden, J., & Sims, V. (2008). Working memory deficits in boys with Attention-deficit/Hyperactivity Disorder 76 (ADHD): The contribution of central executive and subsystem processes. *Journal of Abnormal Child Psychology*, *36*, 825–837. <https://doi.org/10.1007/s10802-008-9215-y>
- Rapport, M. D., Chung, K. M., Shore, G., & Isaacs, P. (2001). A conceptual model of child psychopathology: Implications for understanding attention deficit hyperactivity disorder and treatment efficacy. *Journal of Clinical Child Psychology*, *30*(1), 48–58. https://doi.org/10.1207/s15374424jccp3001_6
- Reitan, R. M., & Wolfson, D. (1995). Influence of age and education on neuropsychological test results. *The Clinical Neuropsychologist*, *9*(2), 151–158. <https://doi.org/10.1080/13854049508401597>
- Retz, W., Stieglitz, R. D., Corbisiero, S., Retz-Junginger, P., & Rösler, M. (2012). Emotional dysregulation in adult ADHD: What is the empirical evidence? *Expert Review of Neurotherapeutics*, *12*, 1241–1251. <https://doi.org/10.1586/ern.12.109>
- Rhodes, S. M., Park, J., Seth, S., & Coghill, D. R. (2012). A comprehensive investigation of memory impairment in attention deficit hyperactivity disorder and oppositional defiant disorder. *Journal of Child Psychology and Psychiatry*, *53*(2), 128–137. <https://doi.org/10.1111/j.1469-7610.2011.02436.x>
- Rothman, K. J., Gallacher, J. E. J., & Hatch, E. E. (2013). Why representativeness should be avoided. *International Journal of Epidemiology*, *42*, 1012–1014. <https://doi.org/10.1093/ije/dys223>
- Rucklidge, J. J., & Tannock, R. (2001). Psychiatric, psychosocial, and cognitive functioning of female adolescents with ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*, 530–540. <https://doi.org/10.1097/00004583-200105000-00012>
- Rutherford, H. J., Booth, C. R., Crowley, M. J., & Mayes, L. C. (2016). Investigating the relationship between working memory and emotion regulation in mothers. *Journal of Cognitive Psychology*, *28*(1), 52–59. <https://doi.org/10.1080/20445911.2015.1075542>
- Schweiger, A., Abramovitch, A., Doniger, G. M., & Simon, E. S. (2007). A clinical construct validity study of a novel computerized battery for the diagnosis of ADHD in young adults. *Journal of Clinical and Experimental Neuropsychology*, *29*(1), 100–111. <https://doi.org/10.1080/13803390500519738>
- Séguin, J. R., Pihl, R. O., Harden, P. W., Tremblay, R. E., & Boulerice, B. (1995). Cognitive and neuropsychological characteristics of physically aggressive boys. *Journal of Abnormal Psychology*, *104*, 614. <https://doi.org/10.1037/0021-843X.104.4.614>
- Seidman, L. J. (2006). Neuropsychological functioning in people with ADHD across the lifespan. *Clinical Psychology Review*, *26*, 466–485. <https://doi.org/10.1016/j.cpr.2006.01.004>
- Shanahan, M. A., Pennington, B. F., Yerys, B. E., Scott, A., Boada, R., Willcutt, E. G., . . . DeFries, J. C. (2006). Processing speed deficits in attention deficit/hyperactivity disorder and reading disability. *Journal of Abnormal Child Psychology*, *34*, 584. <https://doi.org/10.1007/s10802-006-9037-8>
- Shaw, P., Stringaris, A., Nigg, J., & Leibenluft, E. (2014). Emotion dysregulation in attention deficit hyperactivity disorder. *American Journal of Psychiatry*, *171*(3), 276–293. <https://doi.org/10.1176/appi.ajp.2013.13070966>
- Silverstein, M. J., Faraone, S. V., Alperin, S., Leon, T. L., Biederman, J., Spencer, T. J., & Adler, L. A. (2019). Validation of the Expanded Versions of the Adult ADHD Self-Report Scale v1.1 Symptom Checklist and the Adult ADHD Investigator Symptom Rating Scale. *Journal of Attention Disorders*, *23*, 1101–1110. <https://doi.org/10.1177/1087054718756198>

- Silverstein, M. J., Faraone, S. V., Leon, T. L., Biederman, J., Spencer, T. J., & Adler, L. A. (2020). The relationship between executive function deficits and DSM-5-defined ADHD symptoms. *Journal of Attention Disorders, 24*(1), 41–51. <https://doi.org/10.1177/1087054718804347>
- Skirrow, C., & Asherson, P. (2013). Emotional lability, comorbidity and impairment in adults with attention-deficit hyperactivity disorder. *Journal of Affective Disorders, 147*(1–3), 80–86. <https://doi.org/10.1016/j.jad.2012.10.011>
- Stringaris, A. (2011). Irritability in children and adolescents: a challenge for the DSM 5. *European Child & Adolescent Psychiatry, 20*, 61–66. <https://doi.org/10.1007/s00787-010-0150-4>
- Surman, C. B., Biederman, J., Spencer, T., Miller, C. A., McDermott, K. M., & Faraone, S. V. (2013). Understanding deficient emotional self-regulation in adults with attention deficit hyperactivity disorder: A controlled study. *ADHD Attention Deficit and Hyperactivity Disorders, 5*(3), 273–281. <https://doi.org/10.1007/s12402-012-0100-8>
- Surman, C. B., Biederman, J., Spencer, T., Miller, C. A., Petty, C. R., & Faraone, S. V. (2015). Neuropsychological deficits are not predictive of deficient emotional self-regulation in adults with ADHD. *Journal of Attention Disorders, 19*, 1046–1053. <https://doi.org/10.1177/1087054713476548>
- Surman, C. B., Biederman, J., Spencer, T., Yorks, D., Miller, C. A., Petty, C. R., & Faraone, S. V. (2011). Deficient emotional self-regulation and adult attention deficit hyperactivity disorder: A family risk analysis. *American Journal of Psychiatry, 168*, 617–623. <https://doi.org/10.1176/appi.ajp.2010.10081172>
- Thaler, N. S., Bello, D. T., & Etcoff, L. M. (2013). (2013) WISC-IV profiles are associated with differences in symptomatology and outcome in children with ADHD. *Journal of Attention Disorders, 17*(4), 291–301. <https://doi.org/10.1177/1087054711428806>
- Theiling, J., & Petermann, F. (2014). Neuropsychological profiles on the WAIS-IV of ADHD adults. *Journal of Attention Disorders, 20*, 913–924. <https://doi.org/10.1177/1087054713518241>
- Theiling, J., Petermann, F., & Daseking, M. (2013). Relationship between self-reported ADHD symptoms and WAIS-IV performance. *Gesundheitswesen (Bundesverband Der Ärzte Des Öffentlichen Gesundheitsdienstes (Germany)), 75*, 768–774. <https://doi.org/10.1055/s-0033-1357163>
- Thorsen, A. L., Meza, J., Hinshaw, S., & Lundervold, A. J. (2018). Processing speed mediates the longitudinal association between ADHD symptoms and preadolescent peer problems. *Frontiers in Psychology, 8*, 2154. <https://doi.org/10.3389/fpsyg.2017.02154>
- Tucha, L., Fuermaier, A. B., Koerts, J., Buggenthin, R., Aschenbrenner, S., Weisbrod, M., Tucha, O. (2017). Sustained attention in adult ADHD: Time-on-task effects of various measures of attention. *Journal of Neural Transmission, 124*(S1), 39–53. <https://doi.org/10.1007/s00702-015-1426-0>
- Uderman, J. Z. (2015) Working Memory Deficits and Emotion Dysregulation in Youth with Attention-Deficit/Hyperactivity Disorder: Understanding Relationships and Treatment Implications. *Academicworks.cuny.edu* 2015.
- Wechsler, D. (1997) *The Wechsler Adult Intelligence Scale* (3rd ed.). San Antonio, TX: Psychological Corporation.
- Wechsler, D., Coalson, D. L., & Raiford, S. E. (2008). *WAIS-IV technical and interpretive manual*. San Antonio, TX: Pearson.
- Wechsler, D., Nyman, H., & Nordvik, H. (2003). *WAIS-III: Wechsler Adult Intelligence Scale Manual*. Norsk Versjon. Stockholm, Sweden: Psykologiförlaget.
- Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2015). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry, 57*, 1336–1346. <https://doi.org/10.1016/j.biopsych.2005.02.006>
- Woods, S. P., Lovejoy, D. W., & Ball, J. D. (2002). Neuropsychological characteristics of adults with ADHD: A comprehensive review of initial studies. *The Clinical Neuropsychologist, 16*(1), 12–34. <https://doi.org/10.1076/clin.16.1.12.8336>
- World Health Organization. (2003). Adult ADHD Self-Report Scale-V1. 1 (ASRS-V1. 1) Symptom Checklist. Retrieved from *WHO Composite International Diagnostic Interview*.

Yang, P., Cheng, C. P., Chang, C. L., Liu, T. L., Hsu, H. Y., & Yen, C. F. (2013). Wechsler Intelligence Scale for Children 4th edition-Chinese version index scores in Taiwanese children with attention-deficit/hyperactivity disorder. *Psychiatry and Clinical Neurosciences*, *67*(2), 83–91. <https://doi.org/10.1111/pcn.12014>

Received 1 December 2020; revised version received 18 June 2021