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.

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Espen Anker, MD, Oslo ADHD Clinic, Kirkeveien 64B, 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.
INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is a life-span neuropsychiatric disorder, with core symptoms of inattention, hyperactivity, and impulsivity\textsuperscript{[5-6]}. ADHD is caused by a multitude of additive and interactive genetic and environmental factors operating in a complex manner\textsuperscript{[3-4]}. The prevalence of ADHD in the general adult population is estimated to be 3%-5\%\textsuperscript{[6,7]}. Furthermore, ADHD is a dimensional diagnosis in which attention deficits and hyperactivity-impulsivity may appear in various degrees and combinations\textsuperscript{[8]}.

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\textsuperscript{[6,8-9]}, 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\textsuperscript{[10-13]}. They may be quick to anger, easily frustrated, and emotionally over-excitable, a symptom cluster defined as emotional dysregulation (ED)\textsuperscript{[14-16]}. Although ED may be understood as a transdiagnostic factor\textsuperscript{[17]}, in the development of psychopathology\textsuperscript{[18]} it appears to be specifically related to impulsivity\textsuperscript{[19]}. ED is

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

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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.

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associated with SUD in children and adolescents\(^2\) as well as in adults with ADHD\(^2\). The strong relationship between ADHD and ED\(^1\)-\(^3\) 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\(^2\), 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\(^2\). 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\(^3\). 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\(^3\).

ED was assessed by questionnaire with 8 items from the 99-item Current Behavior Scale - Self Report questionnaire\(^4\)-\(^8\). 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 \( \chi^2 \) 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.

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\(^{38}\). 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.
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)     | 227 (38.8)            |
| Range               | 18-67        | 18-69          | 18-69                 |
| Years of education: ≤ 12 | 172 (54.3)   | 129 (48.1)     | 301 (51.5)            |
| > 15                | 24 (7.6)     | 31 (11.6)      | 55 (9.4)              |
| Work participation  | 193 (60.9)   | 149 (55.6)     | 342 (58.5)            |
| ADHD symptom severity, mean ± SD | 50.4 (9.5) | 52.3 (9.5) | 51.4 (9.5) |
| Inattention, mean ± SD | 27.0 (4.6) | 27.8 (4.9) | 27.4 (4.7) |
| Impulsivity-hyperactivity, mean ± SD | 23.3 (6.6) | 24.7 (6.5) | 24.0 (6.6) |
| Emotional dysregulation, mean ± SD | 11.0 (5.6) | 13.4 (5.3) | 12.1 (5.6) |

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

*P < 0.05.

bP < 0.01.

cP < 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)        | 31 (5.3)              |
| - Lifetime           | 47 (14.8)    | 23 (8.6)       | 70 (12.0)             |
| DUD                 |              |                |                       |
| - 12-mo             | 55 (17.4)    | 25 (9.1)       | 80 (13.7)             |
| - Lifetime           | 103 (32.5)   | 59 (22.0)      | 162 (27.7)            |
| AUD or DUD           |              |                |                       |
| - 12-mo             | 67 (21.1)    | 29 (10.8)      | 96 (16.4)             |
| - Lifetime           | 114 (36.0)   | 65 (24.3)      | 179 (30.6)            |

aP < 0.05.

bP < 0.01; women compared with men (χ²). Figures are given in numbers (percentage). AUD: Alcohol use disorder; DUD: Drug use disorder.

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 and DUD\(^44\) — for example, maternal DUD\(^46\). Third, drug dependence, especially the misuse of amphetamine and cannabis, has been suggested to result from self-medication related to ADHD symptoms\(^47,48\), 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\(^49,50\). In line with others,
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 vs 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 vs 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.

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 addiction\(^{[54]}\). 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\(^{[53]}\). 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]
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: 22963648 DOI: 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 DOI: 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 DOI: 10.4172/2157-7412.1000104]
symptoms and borderline personality features among male patients with substance use disorders. Br J Psychiatry 2007; 190: 402-409 [PMID: 17470954 DOI: 10.1192/bjp.bp.106.034389]

5 Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, Faraoe SV, Greenhill LL, Howes MJ, Seckin 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]

6 Wilcutt 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]

7 Cortese S, Faraoe SV, Bernardi S, Wang S, Blanco C. Gender differences in lifetime hyperactivity and 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]

8 Biederman J, Monuteaux MC, Mick E, Spencer T, Wilens TE, Silva JM, Snyder LE, Faraoe SV. Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. Psychol Med 2006; 36: 167-179 [PMID: 1642071] DOI: 10.1017/s0033291705006410

9 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]

10 Charach A, Yeung E, Clinans 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]

11 Solberg BS, Halmyo A, Engeland A, Iglund J, Haakang C, Kjungsvay 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]

12 Vogel T, Dom G, van de Glind G, Studer J, Gmel G, Steik W, Moghaddam B. Emotion dysregulation in 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]

13 Fatséas M, Hurmic H, Serre F, Debrabant R, Daouleude EP, Denis C, Auriautomo 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: 27842425 DOI: 10.1016/j.psychres.2016.10.071]

14 Young JT, Carruthers S, Kaye S, Allop S, Gilsonen A, 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 Res 2015; 34: 683-693 [PMID: 25790353 DOI: 10.1111/dar.12249]

15 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: 10.1177/0959829818752611]

16 Shaw P, Stringaris A, Nigg JT, Leibenluft E. Emotion dysregulation in attention deficit hyperactivity disorder. Am J Psychiatry 2014; 171: 276-293 [PMID: 24480998 DOI: 10.1176/appi.appl.2013.13070966]

17 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]

18 Landaa ET, Halmyo A, Oederega KJ, Fasmer OB, Haakang C. The impact of cyclothymic temperament in adult ADHD. J Affect Disord 2012; 142: 241-247 [PMID: 22846630 DOI: 10.1016/j.jad.2012.04.034]

19 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: 10.1016/j.jaac.20100500-00011]

20 Faraoe SV, Rostain AL, Blader J, Busch B, Childress AC, Connor DF, Newhorn JC. 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]

21 Reimherr FW, Roessler M, Marchant BK, Giff 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]

22 Gisbert I, Vilars L, Rovira M, Sánchez-Mora C, Pagérols M, García-Martínez I, Rovira P, Sánchez-Mora C, Pagerols M, Garcia-Martínez I, Richarte V, Corrales M, Casas M, Ramos-Quirujo 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: 31085061 DOI: 10.1016/j.euroneuro.2019.04.004]

23 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/s0954579416006338]

24 Schreiber LR, Grant JE, O’Dough BL. Emotion regulation and impulsivity in young adults. J Psychiatr Res 2012; 46: 651-658 [PMID: 22385601 DOI: 10.1016/j.jpsychires.2012.02.005]

25 Sobanski E, Banaschewska T, Ashporen P, Buitelaar J, Chen W, Franke B, Holtmann M, Kramm B, Sergeant J, Sonuga-Barke E, Stringaris A, Taylor E, Anney R, Ebstein RP, Gill M, Miranda A, Mulas F, Oades RD, Roseve R, Rothberger A, Steinhausen HC, Farooe 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: 20312417 DOI: 10.1111/j.1469-7610.2010.02217.x]

26 Evren C, Karabulut V, Akhter I, Evren B, Carkci OH, Yilmaz Cengel H, Ozkara Menekseoglu P, Cetin T, Buzkurt M, Umurt G. Emotion dysregulation and internalizing symptoms affect relationships between ADHD symptoms and borderline personality features among male patients with substance use disorders. Psychiatry
Anker E et al. Substance use disorder in adult ADHD

cand. Child Psychopharmacol 2019; 29: 696-706 [DOI: 10.1080/24750573.2019.1595271]

Kooij JJS, Francken MH. Diagnostic interview for ADHD in adults 2.0 (DIVA 2.0). Adult ADHD: Diagnostic assessment and treatment, 33-99 [DOI: 10.1007/978-3-642-41389-3_3]

Sheehan DV, Lecrubier Y, Sheehan KH, Janavs J, Weiller E, Kostiner 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 Psychiatr 1997; 12: 232-41 [DOI: 10.1016/S0924-9380(97)83297-X]

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.equiz 34-57 [PMID: 9815385 DOI: 10.1080/18597-000]

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/cmx115]

Fredrikson M, Dahl AA, Martinsen EW, Klungsøyr 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]

Barryka RA. Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. Psychol Bull 1997; 121: 65-94 [DOI: 10.1037/0033-2909.121.1.65]

Barryka RA, Murphy KR, Robison RJ, Reimherr FW, Marchant BK, Kondo D, Coon H, Rosen PJ, Epstein NJ. 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]

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 Hyperprot Disord. 2013 Sep; 24: 27-73 [PMID: 23413201 DOI: 10.1016/j.adhd.2012.01.000-8]

IBM Corp. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. 2013 [DOI: 10.1045/19781526435439]

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: 26203907 DOI: 10.1001/jamapsychiatry.2015.0584]

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.euroenceuro.2005.04.001]

Bratberg GH, C Wilsnakc S, Wilsnack R, Hâvâs Hauðland S, Krokstad S, Sund ER, Bjørgenah 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]

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: 26268013 DOI: 10.1001/jamapsychiatry.2015.2112]

Kendler KS, Angen 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]

Kringlen 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]

Denomits D, Walters RK, Martin J, Mattheisen M, Als TD, Aggero E, Balderusson G, Byleberg-Grauholm J, Bakvd-Hansen M, Cerrato-Eriksen LO, Chomenko N, Gandal M, Goldstein JI, Grasby KL, Grove J, Gudmundsdottir OO, Hansen LS, Hauberg ME, Hollegaard MV, Howrigan DP, Huang M, Muller JB, Martin AR, Martin NG, Moran J, Pallese J, Palmer DS, Pedersen CB, Pedersen MG, Poterba T, Poulsen JB, Ripples S, Robinson EB, Satterstrom FK, Stefansson H, Stevens C, Turley P, Walters GW, Bionde W, Wright MJ; ADHD Working Group of the Psychiatric Genomics Consortium (PGC); Early LifeCourse & Genetic Epidemiology (EAGLE) Consortium; 23andMe Research Team, Andreade OA, Asherson P, Burton CL, Boomsma DI, Cornall B, Dalsgaard S, Franke B, Gelerentr J, Geschwind D, Hakonarson H, Haavik J, Kranzler HR, Kuntsi J, Langley K, Lesch KP, Midladdarp 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, Nordenfolt M, Hougaard DM, Werge T, Mors O, Mortensen PB, Daly MJ, Faraone SV, Berglam 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]

Wang K, Gaitzch P, Poon H, Cowtux J, Rzheshtyk 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]

Sanchez-Roige S, Fontanilla 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]

Thapar A, Langley K, Asherson P, Gill M. Gene-environment interaction 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]

Wilens TE. Impact of ADHD and its treatment on substance abuse in adults. J Clin Psychiatry 2004; 65 Suppl 3: 38-45 [PMID: 15046534]

Wilens TE, Adamson J, Sgambari S, Whiteley 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
Anker E et al. Substance use disorder in adult ADHD

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 Cheetham 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.2010.04.003]
