# The impact of attention-deficit hyperactivity disorder across the lifespan on substance use disorders

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**Introduction**
Attention-deficit hyperactivity disorder (ADHD) affects not only children, but persists into adulthood with a prevalence rate up to 4.4% in the general population. The association between ADHD and substance use disorders (SUDs) is getting more into the scientific focus. However, the impact of ADHD on SUD regarding the economic system and healthcare is still underestimated.

**Aim of the work**
The aim of this study was to analyze the impact of childhood and adult ADHD on SUD by comparing the SUD clinical outcome between a group of SUD inpatients having a history of childhood ADHD and another group of SUD inpatients having concurrent adult ADHD.

**Participants and methods**
A cross-sectional comparative study was conducted at the Addiction Treatment Center at El Maamoura Mental Hospital. In all, 102 adult male patients were assessed using a clinical psychiatric interview and psychometric assessment using the Arabic version of Wender Utah Rating Scale for retrospective assessment of symptoms of childhood ADHD. Also, the Arabic version of the Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist was used to screen for adult ADHD.

**Results**
Sixty-four patients out of the total studied sample had a history of childhood ADHD. Of them, only 36 patients fulfilled the DSM-IV-TR criteria for adult ADHD. The presence of adult ADHD was associated with an earlier mean age of onset of SUD (13.22 vs. 14.86 years), a larger number of hospital admissions (4.21 vs. 6.83 times), and a shorter mean period of abstinence (124.53 vs. 271.50 days) than patients with a history of childhood ADHD.

**Conclusion**
In comparison with childhood ADHD, the presence of adult ADHD among patients with SUD was associated with a more complicated course of SUDs and a poorer clinical outcome.

**Keywords:**
adult attention-deficit hyperactivity disorder, adult ADHD self-report scale, clinical outcome, impact, substance use disorders, wender utah rating scale

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## Introduction

The link between attention-deficit hyperactivity disorder (ADHD) and substance use disorders (SUDs) goes back to the 1970s when Goodwin *et al.* (1975) found a comorbidity of ADHD and alcoholism or substance abuse in 35–70% of their patients. Almost 8 years later, Mannuzza *et al.* (1993) conducted a 16-year prospective study on ADHD cohorts and a matched control group. They found a four-fold higher rate of drug use disorder in ADHD cohorts compared with controls (Mannuzza *et al.*, 1993). Different models of comorbidity are generally proposed to link different psychiatric illnesses to SUD. First, the psychiatric disorder may occur in the context of withdrawal from SUD or as a result of chronic intoxication. Second, the psychiatric disorder may be considered as a risk factor for SUD or substances of abuse may be used as a self-medication to reduce symptoms of the psychiatric disorder. Third, both the psychiatric disorder and SUD may have a common genetic predisposition or a common environmental risk factor. Fourth, SUD may act as a modifying factor through the course of already present psychiatric disorders (Regier *et al.*, 1990, 1993; Kessler *et al.*, 1994). Patients with SUD and comorbid ADHD have a greater severity of substance abuse, conduct problems, and worse treatment outcomes (Sullivan, 2001; Moura *et al.*, 2013). However, the impact of ADHD on SUD is still underestimated and needs further elucidation.

## Aim of the work

The aim of this study was to analyze the impact of childhood and adult ADHD on SUD clinical outcome measures between a group of SUD inpatients having a history of childhood ADHD and another group of SUD inpatients having concurrent adult ADHD.

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## Participants and methods

This study was designed as a cross-sectional study that included 102 male inpatients with SUD chosen randomly from the Addiction Treatment Center (ATC) at the El Maamoura Psychiatric Hospital during the period of 6 months starting on 1 January 2011 till 30 June 2011. Inclusion criteria were age between 18 and 60 years, male sex, *Diagnostic and Statistical Manual for Mental Disorders*, 4th ed., text-revised (DSM-IV-TR) diagnosis of SUD (??,2000), and patients' informed written consent given after their detoxification therapy. Exclusion criteria included any psychiatric disorder other than ADHD, physical and neurological diseases, and patients in their detoxification period. All recruited individuals were subjected to (a) a semistructured interview questionnaire to collect their sociodemographic data, history of substance use, medical and psychiatric history, and SUD clinical outcome measures (the type and the number of abused substances, the age of onset of SUD, the number of hospital admissions, the longest duration of abstinence, and the presence of legal problems), (b) physical and neurological examination, (c) a psychiatric interview using the DSM-IV-TR diagnostic criteria, (d) the Arabic translated and validated version of the Wender Utah Rating Scale (WURS) (Wender, 1995), and (e) the Arabic translated and validated version of the Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist (Daigre *et al.*, 2009; Van De Glind *et al.*, 2013a).

### The Wender Utah Rating Scale for the retrospective assessment of symptoms of childhood attention-deficit hyperactivity disorder (Wender, 1995)

The 61 questions are answered by the adult patient recalling his or her childhood behavior with five possible responses scored from 0 to 4 points. The minimum score for the 25 questions is 0 and the maximum score is 100. A cut off score of 46 was used, 86 patients with ADHD 99 of normal persons and 81% of depressed individuals were correctly classified (Wender, 1995). The Arabic version was subjected to a jury with five professionals to assess its acceptance to the Arabic culture. The reliability of the scale in its Arabic format was tested using Cronbach's α through the following process:

(1) A pilot study in which the Arabic version was used on a sample containing 30 patients.
(2) Cronbach's α was calculated to be 0.847 (significant if >0.7).

### The Adult ADHD Self-Report Scale Symptom Checklist (Daigre *et al.*, 2009; Van De Glind *et al.*, 2013a)

The Symptom Checklist is an instrument consisting of the 18 DSM-IV-TR criteria. Six of the 18 questions were found to be the most predictive of symptoms consistent with ADHD. These six questions are the basis for the ASRS v1.1 screener and are also part A of the Symptom Checklist. Part B of the Symptom Checklist contains the remaining 12 questions. If four or more marks appear in the darkly shaded boxes within part A, then the patient has symptoms highly consistent with ADHD in adults and further investigation is warranted. The frequency scores on part B provide additional cues and can serve as further probes into the patient's symptoms. No total score or diagnostic likelihood is utilized for the 12 questions. It has been found that the six questions in part A are the most predictive of the disorder and are the best for use as a screening instrument (Daigre *et al.*, 2009; Van De Glind *et al.*, 2013a). The Arabic version was subjected to a jury with five professionals to assess its acceptance to the Arabic culture. The reliability of the scale in its Arabic format was tested using Cronbach's α through the following process:

(1) A pilot study in which the Arabic version was used on a sample containing 30 patients.
(2) Cronbach's α was calculated to be 0.717 (significant if >0.7).

### Statistical analysis

Data were fed into the computer using the Predictive Analytics Software (PASW Statistics 18, Baltim, California, Wadsworth Cengage Learning, USA 2013). Qualitative data were described using number and percent. The association between categorical variables was tested using the $\chi^2$-test. Quantitative data were described using median, minimum, and maximum as well as the mean and SD. The significance of the obtained results was judged at the 5% level.

## Results

The recruited sample consisted of 102 men, and their ages ranged from 19 to 53 years, with a mean of 31.16 ± 5.96 years. The results of this study sought firstly to define the sample into three groups: group I, SUD patients with no ADHD; group II, SUD patients with adult ADHD; and group III, SUD patients with childhood ADHD. Second, groups I and II were compared regarding the SUD clinical outcome, and a multivariate regression was performed to delineate the prognostic factors of adult ADHD and its impact on the SUD clinical outcome. Third, the prognostic impact factors were compared between groups II and III in an attempt to differentiate between the impact of childhood and adult ADHD on SUD.

First, the administration of the Arabic version of WURS concluded that 64 (63.7%) patients had a

positive history of childhood ADHD, whereas 38 (37.3%) patients screened negative. As for the Arabic version of the ASRS-v1.1 Symptom Checklist, 44 (43.1%) patients had positive results for adult ADHD symptoms, whereas 58 (56.9%) screened negative. Patients who screened positive for the Arabic version of the ASRS-v1.1 Symptom Checklist were subjected to a semistructured interview to diagnose adult ADHD according to the DSM-IV-TR diagnostic criteria. Only 36 (35.3%) patients were diagnosed as having adult ADHD according to DSM-IV-TR. Therefore, groups I, II, and III included 66, 36, and 28 patients, respectively (Table 1).

Second, (a) a comparison was made between SUD patients without adult ADHD (group I) and SUD patients with adult ADHD (group II) regarding the type and the number of abused substances, the age of onset of SUD, the number of hospital admissions, the longest duration of abstinence, and the presence of legal problems. Regarding the type of substance abused, all patients abused opioids and cannabis, whereas the ADHD group abused more cocaine and alcohol, and less of other medications and pills compared with the non-ADHD group; however, none of these differences reached statistical significance except for cocaine use ($P = 0.014$) (Table 2).

Further comparison of the clinical outcome revealed statistical significance for the SUD patients with adult ADHD who had an earlier age of onset of SUD ($P = 0.001$), a shorter duration of abstinence ($P = 0.045$), more hospital admissions ($P = 0.049$), and more legal problems ($P = 0.02$). However, there was no statistical difference between both groups regarding the number of abused substances ($P = 0.6$) (Table 3).

(b) A multivariate regression model was performed to assess significant variables of substance abuse in relation to the presence or the absence of adult ADHD. The most significant variables were substance abuse onset with an odds ratio of 0.861, the number of hospital admissions with an odds ratio of 1.125, and sniffing as a preferred route of administration of heroin with an odds ratio of 2.614 (Table 4).

**Table 1 Distribution of the total studied sample ($n = 102$) according to the presence of adult ADHD**

| ADHD diagnosis | *n* (%) |
|---|---|
| Presence of childhood ADHD according to WURS | |
| No | 38 (37.3) |
| Yes | 64 (63.7) |
| Screening for adult ADHD according to ASRS-v1.1 | |
| No | 58 (56.9) |
| Yes | 44 (43.1) |
| Presence of adult ADHD (DSM-IV-TR) | |
| No | 66 (64.7) |
| Yes | 36 (35.3) |

ADHD, attention-deficit hyperactivity disorder; ASRS-v1.1, Adult ADHD Self-Report Scale; WURS, Wender Utah Rating Scale.

**Table 2 Comparison between the non-ADHD group (group I) and the ADHD group (group II) according to the substance of abuse**

| Type of substance | Group I non-ADHD ($n = 66$) [*n* (%)] | Group II ADHD ($n = 36$) [*n* (%)] |
|---|---|---|
| Alcohol | | |
| No | 30 (45.5) | 12 (33.3) |
| Yes | 36 (54.5) | 24 (66.7) |
| $\chi^2$ (*P*) | | 1.413 (0.235) |
| Cannabis | | |
| No | 0 (0.0) | 0 (0.0) |
| Yes | 66 (100.0) | 36 (100.0) |
| Benzodiazepines | | |
| No | 38 (57.6) | 14 (38.9) |
| Yes | 28 (42.4) | 22 (61.1) |
| $\chi^2$ (*P*) | | 3.255 (0.071) |
| Opioids | | |
| No | 0 (0.0) | 0 (0.0) |
| Yes | 66 (100.0) | 36 (100.0) |
| Cocaine | | |
| No | 66 (100.0) | 32 (88.9) |
| Yes | 0 (0.0) | 4 (11.1) |
| FEp | | 0.014* |
| Other substances of abuse | | |
| No | 32 (48.5) | 24 (66.7) |
| Yes | 34 (51.5) | 12 (33.3) |
| $\chi^2$ (*P*) | | 3.110 (0.078) |

ADHD, attention-deficit hyperactivity disorder; FEp, *P* value for the Fisher exact test, *Statistically significant at $P \leq 0.05$.

**Table 3 Comparison between SUD patients with no ADHD and SUD patients with adult ADHD regarding the clinical outcome measures**

| Clinical outcome measures | Group I (SUD patients with no ADHD) | Group II (SUD patients with adult ADHD) | *P* value |
|---|---|---|---|
| Substance abuse onset | | | |
| Range | 10–31 | 8–18 | 0.001* |
| Mean ± SD | 15.6 ± 3.9 | 13.22 ± 2.63 | |
| Median | 15 | 13 | |
| Number of abused substances | | | |
| Range | 3–6 | 4–7 | 0.6 |
| Mean | 4.5 ± 0.1 | 4.7 ± 0.9 | |
| Median | 5 | 4 | |
| Number of hospital admissions | | | |
| Range | 1–20 | 1–30 | 0.049* |
| Mean ± SD | 3.4 ± 4 | 6.83 ± 8.05 | |
| Median | 2 | 3 | |
| Longest period of abstinence | | | |
| Range | 14–1200 | 14–700 | $^{MW}P = 0.045$* |
| Mean ± SD | 209.8 ± 282 | 124.5 ± 171.9 | |
| Median | 105 | 37.5 | |
| Legal problems [*n* (%)] | | | |
| Absent | 54 (81.8) | 22 (61.1) | $\chi^2$ (*P*) = 5.3 (0.02)* |
| Present | 12 (18.2) | 14 (38.9) | |

ADHD, attention-deficit hyperactivity disorder; *P*, *P* value for the Student *t*-test; SUD, substance use disorder; *Statistically significant at $P \leq 0.05$.

**Table 4 Multivariate regression analysis for substance abuse at onset, the number of hospital admissions, the longest period of abstinence, legal problems, and sniff**

| Clinical outcome measures | *B* | Significance | OR | 95.0% CI (lower–upper) |
|---|---|---|---|---|
| Substance abuse onset | −0.150 | 0.047 | 0.861* | 0.742–0.998 |
| Number of hospital admissions | 0.118 | 0.029 | 1.125* | 1.012–1.251 |
| Longest period of abstinence | −0.002 | 0.151 | 0.998 | 0.995–1.001 |
| Legal problems | 0.316 | 0.599 | 1.372 | 0.422–4.455 |

CI, confidence interval; OR, odds ratio; *Statistically significant.

Third, on comparing the prognostic clinical outcome measures concluded from the regression analysis, SUD patients with a history of childhood ADHD had a later age of onset of SUD ($P = 0.04$), a longer duration of abstinence ($P = 0.03$), and less exposure to legal problems ($P = 0.03$), compared with SUD patients with adult ADHD. However, there was no statistical difference between both groups regarding the number of hospital admissions ($P = 0.4$) (Table 5).

**Table 5 Comparison between childhood ADHD patients and adult ADHD patients regarding the impact of prognostic factors**

| Impact factors | Group III (SUD patients with childhood ADHD) | Group II (SUD patients with adult ADHD) | *P* value |
|---|---|---|---|
| Substance abuse onset | | | |
| Range | 11–23 | 8–18 | 0.04* |
| Mean ± SD | 14.9 ± 2.9 | 13.2 ± 2.6 | |
| Median | 15 | 13 | |
| Number of hospital admissions | | | |
| Range | 1–20 | 1–30 | 0.4 |
| Mean ± SD | 4.2 ± 4.9 | 6.8 ± 8.1 | |
| Median | 3 | 3 | |
| Longest period of abstinence | | | |
| Range | 14–1200 | 14–700 | 0.03* |
| Mean ± SD | 271.5 ± 363.9 | 124.5 ± 171.9 | |
| Median | 120 | 37.5 | |
| Legal problems [*n* (%)] | | | |
| Absent | 24 (85.7) | 22 (61.1) | 0.03* |
| Present | 4 (14.3) | 14 (38.9) | |

ADHD, attention-deficit hyperactivity disorder; *P*, *P* value for the Student *t*-test; SUD, substance use disorder; *Statistically significant at $P \leq 0.05$.

## Discussion

Complicating the clinical picture of ADHD is the fact that as many as 50% of the individuals with the disorder will meet the criteria for at least one comorbid psychiatric condition (Kessler *et al.*, 2006; Wilens, 2006). Research has demonstrated that substance abuse in adulthood has associations with ADHD and that failure to treat the disorder may result in a higher likelihood of substance use-associated problems (Barkley *et al.*, 2006; Wilens and Upadhyaya, 2007; Tamm *et al.*, 2013). The fact that ADHD is likely to occur with SUD adds to the clinical complexity of both diagnosing and treating the disorder and amplifies the potential for adverse life outcomes. The present study investigated the impact of co-occurrence of childhood and adult ADHD on SUD in a sample of Egyptian inpatients with SUD regarding clinical outcome measures. Among our sample, 64 (63.7%) patients had a history of childhood ADHD and only 36 (35.3%) patients continued to have the manifestation of ADHD as adults according to the DSM-IV-TR criteria, that is, the persistence of childhood ADHD symptoms into adulthood occurred in 56.3% of the children. The study results were congruent with the literature, which stated that the persistence of ADHD symptoms into adulthood occurred in 37.5–60% of the affected children, and half of these children will have a comorbid SUD (Barkley *et al.*, 2006; Kessler *et al.*, 2006; Wilens, 2006; Wilens and Upadhyaya, 2007).

Similarly, Clure *et al.* (1999) examined the prevalence and subtypes of ADHD in a group of SUD individuals and found a similar rate of persistence of ADHD into adulthood. Their sample was composed of 136 inpatients with an SUD diagnosis (cocaine vs. alcohol vs. cocaine/alcohol) who were subjected to a structured interview for ADHD. Of the SUD individuals, 32% met the criteria for childhood ADHD, and 35% of those with a childhood diagnosis of ADHD continued to have clinically significant symptoms into adulthood with an overall prevalence of 15% for adult ADHD (Clure *et al.*, 1999). Further, comparable rates for ADHD persistence were found by Carpentier *et al.* (2011), when they examined the prevalence of childhood ADHD, adult ADHD, and conduct disorders in a sample of 193 patients in long-term methadone maintenance treatment. Childhood ADHD was diagnosed in 68 (35.2%) patients; 48 (24.9%) of them had persisting ADHD; conduct disorder history was present in 116 (60.1%) patients (Carpentier *et al.*, 2011). Despite the comparable rates of persisting ADHD, the above studies reported lower prevalence rates for childhood and adult ADHD among SUD patients than ours. In general, the estimation of prevalence rates is a complicated process and varies among studies. The different rates may be attributed to the lack of conformity in the methodology. The different scales utilized, whether inpatients or outpatients were included in the study, different stages of abstinence

or abuse or dependence and variable management of both disorders, different sample sizes, different types of abused substances and its availability, and societal and cultural practices for substance use might have attributed for such differences (Van De Glind *et al.*, 2013b, 2014).

The present work found worse clinical outcome measures for SUD among SUD inpatients with adult ADHD than those without ADHD. A multivariate regression analysis pointed out four predictor factors for such a poor prognosis of SUD, mainly an early age of onset of SUD, more frequent hospital admissions, a shorter period of abstinence, and the presence of legal problems. Furthermore, three of these factors (an early age of onset of SUD, a shorter duration of abstinence, and the presence of legal problems) were significantly worse in adult ADHD than in childhood ADHD among our studied sample. The above-mentioned findings matched a study that concluded that adolescents and adults with ADHD had substance use problems that are typically more substantial than those without ADHD. Individuals with both diagnoses have been reported to have an earlier onset, a longer course, and a greater severity, with more relapses and greater difficulty remaining abstinent (Wilens, 2004). Wilens and Upadhyaya (2007) studied the profile of adults with ADHD regarding substance use, personality, service use, and employment. The sample consisted of 216 consecutive referrals to an adult ADHD service and classified with ADHD, partially or fully remitted ADHD, or no ADHD. Normal controls ($n$ = 33) were recruited from a general practitioner's center. Participants completed measures of alcohol and illicit substance use, employment, service use, ADHD symptoms, and personality. The authors concluded that there were high rates of substance use in participants with current ADHD diagnoses, increased rates of personality trait or disorder scores, and unemployment. There was some indication that those with ADHD and SUD presented more impairment and placed a higher demand on services (Wilens and Upadhyaya, 2007). Recently, Moura *et al.* (2013) conducted a study to evaluate psychiatric comorbidities and different areas of life functioning in substance abusers with ADHD symptoms. It was a cross-sectional, multicenter study involving 285 adult substance abusers from outpatient and inpatient clinics. The ASRS-v1.1, the sixth version of the Addiction Severity Index, and the Mini International Neuropsychiatry Interview were used for data collection. Individuals with comorbid ADHD and SUDs showed increased addiction severity when compared with individuals without ADHD (53.3 ± 7.3 vs. 48.4 ± 8.4, respectively). These results suggested that comorbid ADHD and SUDs are associated with a more severe course of substance use and with social and psychiatric impairment (Moura *et al.*, 2013).

The present study found that cocaine was used significantly more by SUD patients with ADHD than those with no ADHD, and this result matched other studies (Wilens *et al.*, 2005; Ohlmeier *et al.*, 2008; Kaufmann *et al.*, 2011). Ohlmeier *et al.* (2008) found that patients with ADHD consumed a higher quantity of cocaine (75.8 and 71.4% consecutively; $P$ = 0.775). Also, they mentioned a prevalence of 35% in ADHD in combination with addictive illnesses and that cocaine consumption is much more prominent and commences earlier in this patient group than in cocaine addicts without ADHD (Ohlmeier *et al.*, 2008). Also, Kaufmann *et al.* (2011) found that cocaine was more commonly used among ADHD patients in comparison with the non-ADHD group (39 and 14% consecutively) (Kaufmann *et al.*, 2011). It was concluded that cocaine was the preferred substance of use among ADHD patients and this fact was attributed to its stimulant properties as supported by the theory of self-medication (Wilens *et al.*, 2005; Ohlmeier *et al.*, 2008; Kaufmann *et al.*, 2011; Daigre *et al.*, 2013).

In the current study, patients with ADHD had an earlier mean onset of substance abuse problems in comparison with the non-ADHD group (13.22 and 15.58 years consecutively) and the difference was statistically significant ($P$ = 0.001). Similarly, Kim *et al.* (2006) reported that the mean age of onset of pathological drinking was significantly earlier in alcoholics with ADHD compared with alcoholics without ADHD (26.6 and 30.1 years consecutively, $P$ < 0.05) (Kim *et al.*, 2006). Again, Ohlmeier *et al.* (2007) found that alcohol addiction started at an earlier age in patients with comorbid ADHD (exceeding the critical level of alcohol consumption at 27.2 ± 9.52 years with existing ADHD as against 30.6 ± 10.6 years); however, this result was not significant (Ohlmeier *et al.*, 2007). Further, ADHD was also a significant predictor of early initiation of cigarette smoking (before age 15); conduct and mood disorders coupled with ADHD put youth at a particularly high risk for early-onset smoking. Data also suggest that smoking kindles youth with ADHD for an even higher risk of SUDs. This is not surprising, given that smoking leads to peer group pressure and availability of illicit substances and that, biologically, nicotine exposure may make the brain more susceptible to later behavioral problems and SUDs. Furthermore, nicotinic-modulating agents are being evaluated for the treatment of ADHD (Wilens and Morrisson, 2011).

In the current study, patients with ADHD had almost double the mean number for previous hospital

admissions in comparison with the non-ADHD group (6.83 and 3.39 times consecutively) and the difference was statistical significant ($P$ = 0.049). Similarly, Schubiner *et al.* (2000) reported that women with ADHD (in comparison with women without ADHD) had a higher number of treatments for alcohol abuse (Schubiner *et al.*, 2000). The high frequency of hospital admission among ADHD patients was related to the fact that adolescents and young adults with ADHD seeking treatment for SUD are also at a greater risk of treatment failure, as their disruptive behaviors interfere with their ability to be maintained in a treatment facility (Stratton, 1998; Schubiner *et al.*, 2000). The former finding was in accordance with the finding of the present work regarding periods of abstinence. In our sample, patients with ADHD had shorter mean periods of abstinence in comparison with the non-ADHD group (124.53 and 209.82 days consecutively) and the difference was statistically significant ($P$ = 0.045). Further, Seitz *et al.* (2011) reported that patients with adult ADHD were younger, showed higher craving, and had more withdrawal and psychiatric symptoms than patients without ADHD, leading to shorter periods of abstinence (Seitz *et al.*, 2011). Furthermore, Cobos *et al.* (2011) found that patients with probable adult ADHD showed a higher cocaine craving for the previous day, less frequent cocaine abstinence throughout the previous week, and a higher use of cocaine and tobacco during the previous month (Cobos *et al.*, 2011).

Finally, the present work found a significantly higher likelihood for legal problems among SUD patients with ADHD than those with no ADHD. Studies have concluded that ADHD patients are at a heightened risk of antisocial behavior during adolescence/early adulthood and this may explain the frequent legal problems in SUD patients with ADHD (Wilens and Upadhyaya, 2007; Moura *et al.*, 2013; De Sanctis *et al.*, 2014). One study aimed at characterizing the antisocial outcomes of a sample of urban, lower socioeconomic status, ethnically diverse ADHD youth and investigated the impact of maltreatment history on criminal and SUD outcomes. Ninety-eight participants diagnosed with ADHD in childhood were reassessed 10 years later and compared with controls. Regression analyses investigated the effect of maltreatment on antisocial outcomes among four groups on the basis of ADHD and the maltreatment status. ADHD patients and controls did not differ in rates of arrest, conviction, incarceration, or recidivism. However, ADHD youth were younger at their first arrest, with higher rates of SUDs when compared with controls. Controls and ADHD patients with maltreatment had significantly higher rates of SUDs compared with the no-ADHD/no-maltreatment group. Only ADHD youth with maltreatment had significantly higher rates of arrest than the reference group (De Sanctis *et al.*, 2014).

In an attempt to explain the worse prognosis found in the present work, it will help to focus on the common neurobiological background of both ADHD and SUD, signifying more brain areas with dysfunction than one disorder alone, and therefore a worse outcome. The high heritability of ADHD and addiction seen in twin and adoption studies suggests that there are common genes between the two (Todd and Neuman, 2007; Becker *et al.*, 2008; Lesch *et al.*, 2008; Carpentier *et al.*, 2013). Functional MRI studies show reduced frontostriatal circuit activity in both ADHD and SUD, specifically in the dorsal anterior cingulate gyrus – a part of the brain that monitors behavior, suppresses emotional feelings (e.g. cravings), and chooses among competing priorities (Goldstein *et al.*, 2009; Van Wingen *et al.*, 2013). Current data suggest that these genetic, environmental, and drug-induced insults combine to create an area of impaired dopamine neurotransmission. This combination is associated with a diminished perception of reward, worsening cognition, and impaired behavioral inhibition and a greater vulnerability to psychosocial adversity, which in turn lead to a poor prognosis of both disorders (Todd and Neuman, 2007; Becker *et al.*, 2008; Lesch *et al.*, 2008; Goldstein *et al.*, 2009; Carpentier *et al.*, 2013; Van Wingen *et al.*, 2013; Young, 2014).

## Conclusion

The present study showed that the comorbidity between childhood ADHD and SUD is common and that it persisted into adult ADHD in 56.3% of the patients. The comorbidity indicated four poor outcome measures, mainly an early age of onset of SUD, more frequent hospital admissions, a shorter duration of abstinence, and the presence of legal problems. Future Egyptian multicenter studies are recommended with a larger number of patients including both sexes for further clarification of the impact of other outcome measures. Screening for childhood adult ADHD with the Arabic version of WURS and the ASRS-v1.1 Symptom Checklist, respectively, is recommended in evaluating SUD patients. Better management plans for SUD should include screening for ADHD and addressing it with proper treatment.

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### Conflicts of interest

There are no conflicts of interest.

## References


American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders*. 4th ed. Washington, DC: American Psychiatric Association.

Barkley RA, Fischer M, Smallish L, Fletcher K (2006). Young adult outcome of hyperactive children: adaptive functioning in major life activities. J Am Acad Child Adolesc Psychiatry 45:192–202.

Becker K, El-Faddagh M, Schmidt MH, Esser G, Laucht M (2008). Interaction of dopamine transporter genotype with prenatal smoke exposure on ADHD symptoms. J Pediatr 152:263–269.

Carpentier PJ, van Gogh MT, Knapen LJ, Buitelaar JK, De Jong CA (2011). Influence of attention deficit hyperactivity disorder and conduct disorder on opioid dependence severity and psychiatric comorbidity in chronic methadone-maintained patients. Eur Addict Res 17:10–20.

Carpentier PJ, Arias Vasquez A, Hoogman M, Onnink M, Kan CC, Kooij JJ, *et al.* (2013). Shared and unique genetic contributions to attention deficit/hyperactivity disorder and substance use disorders: a pilot study of six candidate genes. Eur Neuropsychopharmacol 23:448–457.

Clure C, Brady KT, Saladin ME, Johnson D, Waid R, Rittenbury M (1999). Attention-deficit/hyperactivity disorder and substance use: symptom pattern and drug choice. Am J Drug Alcohol Abuse 25:441–448.

Daigre Blanco C, Ramos-Quiroga JA, Valero S, Bosch R, Roncero C, Gonzalvo B, Nogueira M (2009). Adult ADHD Self-Report Scale (ASRS-v1.1) symptom checklist in patients with substance use disorders. Actas Esp Psiquiatr 37:299–305.

Daigre C, Roncero C, Grau-López L, Martínez-Luna N, Prat G, Valero S, *et al.* (2013). Attention deficit hyperactivity disorder in cocaine-dependent adults: a psychiatric comorbidity analysis. Am J Addict 22:466–473.

De Sanctis VA, Newcorn JH, Halperin JM (2014). A prospective look at substance use and criminal behavior in urban ADHD youth: what is the role of maltreatment history on outcome? Atten Defic Hyperact Disord 6:79–86.

Goldstein RZ, Alia-Klein N, Tomasi D, Carrillo JH, Maloney T, Woicik PA, *et al.* (2009). Anterior cingulate cortex hypoactivations to an emotionally salient task in cocaine addiction. Proc Natl Acad Sci USA 106:9453–9458.

Goodwin DW, Schulsinger F, Hermansen L, Guze SB, Winokur G (1975). Alcoholism and the hyperactive child syndrome. J Nerv Ment Dis 160:349–353.

Huntley Z, Young S (2014). Alcohol and substance use history among ADHD adults: the relationship with persistent and remitting symptoms, personality, employment, and history of service use. J Atten Disord 18:82–90.

Kaufmann YA, Bavarel JG, Khan R *et al.* (2011). Substance use disorder with comorbid attention deficit hyperactivity disorder. ADHD Attention Deficit Hyperactivity Disorder 3:113.

Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, *et al.* (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, Adler L, Barkley R, Biederman J, Conners CK, Demler O, *et al.* (2006). The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. Am J Psychiatry 163:716–723.

Kim JW, Park CS, Hwang JW, Shin MS, Hong KE, Cho SC, Kim BN (2006). Clinical and genetic characteristics of Korean male alcoholics with and without attention deficit hyperactivity disorder. Alcohol Alcohol 41:407–411.

Lesch KP, Timmesfeld N, Renner TJ, Halperin R, Röser C, Nguyen TT, *et al.* (2008). Molecular genetics of adult ADHD: converging evidence from genome-wide association and extended pedigree linkage studies. J Neural Transm 115:1573–1585.

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.

Moura HF, Faller S, Benzano B, Stat D, Szobot C, Diemen L, *et al.* (2013). The effects of ADHD in adult substance abuse. J Addict Dis 32:252–262.

Ohlmeier MD, Peters K, Kordon A, Seifert J, Wildt BT, Wiese B, *et al.* (2007). Nicotine and alcohol dependence in patients with comorbid attention-deficit/hyperactivity disorder (ADHD). Alcohol Alcohol 42:539–543.

Ohlmeier MD, Peters K, Wildt BT *et al.* (2008). Comorbidity of alcohol and substance dependence with attenion-deficit/hyperactivity disorder (ADHD). Alcohol Alcoholism 43:300–304.

Pérez de Los Cobos J, Sinol N, Puerta C, Cantillano V, López Zurita C, Trujols J (2011). Features and prevalence of patients with probable adult attention deficit hyperactivity disorder who request treatment for cocaine use disorders. Psychiatry Res 185:205–210.

Regier DA, Farmer ME, Rae DS, Locke BZ, Keith SJ, Judd LL, Goodwin FK (1990). Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area (ECA) Study. JAMA 264:2511–2518.

Regier DA, Narrow WE, Rae DS, Manderscheid RW, Locke BZ, Goodwin FK (1993). The de facto US mental and addictive disorders service system. Epidemiologic catchment area prospective 1-year prevalence rates of disorders and services. Arch Gen Psychiatry 50:85–94.

Schubiner H, Tzelepis A, Milberger S, Lockhart N, Kruger M, Kelley BJ, Schoener EP (2000). Prevalence of attention-deficit/hyperactivity disorder and conduct disorder among substance abusers. J Clin Psychiatry 61:244–251.

Seitz A, Allemann P, Klingemann H *et al.* (2011). Association between attention deficit/hyperactivity disorder (ADHD) and craving among patients with Alcohol Use Disorders (AUD). ADHD Attention Deficit Hyperactivity Disorder 3:114.

Stratton J, Gailfus D (1998). A new approach to substance abuse treatment. Adolescents and adults with ADHD. J Subst Abuse Treat 15:89–94.

Sullivan MA, Rudnik-Levin F (2001). Attention deficit/hyperactivity disorder and substance abuse. Diagnostic and therapeutic considerations. Ann N Y Acad Sci 931:251–270.

Tamm L, Trello-Rishel K, Riggs P, Nakonezny PA, Acosta M, Bailey G, Winhusen T (2013). Predictors of treatment response in adolescents with comorbid substance use disorder and attention-deficit/hyperactivity disorder. J Subst Abuse Treat 44:224–230.

Todd RD, Neuman RJ (2007). Gene–environment interactions in the development of combined type ADHD: evidence for a synapse-based model. Am J Med Genet B Neuropsychiatr Genet 144B:971–975.

van de Glind G, van den Brink W, Koeter MW, Carpentier PJ, van Emmerik-van Oortmerssen K, Kaye S, *et al.* IASP Research Group (2013). Validity of the Adult ADHD Self-Report Scale (ASRS) as a screener for adult ADHD in treatment seeking substance use disorder patients. Drug Alcohol Depend 132:587–596.

Van De Glind G, Van Emmerik-van Oortmerssen K, Carpentier PJ, Levin FR, Koeter MWJ, *et al.* (2013b). The International ADHD in Substance Use Disorders Prevalence (IASP) study: background, methods and study population. Int J Method Psychiatr Res 22:232–244.

van de Glind G, Konstenius M, Koeter MW, van Emmerik-van Oortmerssen K, Carpentier PJ, Kaye S, *et al.* IASP Research Group (2014). Variability in the prevalence of adult ADHD in treatment seeking substance use disorder patients: results from an international multi-center study exploring DSM-IV and DSM-5 criteria. Drug Alcohol Depend 134:158–166.

Van Wingen GA, van den Brink W, Veltman DJ, Schmaal L, Dom G, Booij J, Crunelle CL (2013). Reduced striatal brain volumes in non-medicated adult ADHD patients with comorbid cocaine dependence. Drug Alcohol Depend 131:198–203.

Wender PH (1995). *Attention-deficit hyperactivity disorder in adults*. New York, NY: Oxford University Press.

Wilens TE (2004). Attention-deficit/hyperactivity disorder and the substance use disorders: the nature of the relationship, subtypes at risk, and treatment issues. Psychiatr Clin North Am 27:283–301.

Wilens TE (2006). Attention deficit hyperactivity disorder and substance use disorders. Am J Psychiatry 163:2059–2063.

Wilens TE, Upadhyaya HP (2007). Impact of substance use disorder on ADHD and its treatment. J Clin Psychiatry 68:e20.

Wilens TE, Morrison NR (2011). The intersection of attention-deficit/hyperactivity disorder and substance abuse. Curr Opin Psychiatry 24:280–285.

Wilens TE, Kwon A, Tanguay S, Chase R, Moore H, Faraone SV, Biederman J (2005). Characteristics of adults with attention deficit hyperactivity disorder plus substance use disorder: the role of psychiatric comorbidity. Am J Addict 14:319–327.