

# Underdiagnosis of Attention-Deficit/Hyperactivity Disorder in Adult Patients: A Review of the Literature

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## ABSTRACT

**Objective:** To raise awareness of attention-deficit/hyperactivity disorder (ADHD) as an underdiagnosed, undertreated, often comorbid, and debilitating condition in adults.

**Data Sources:** PubMed was searched using combinations of keywords, including *ADHD, adult, diagnosis, identify, prevalence, and comorbid*, to find articles published between 1976 and 2013.

**Study Selection:** In total, 99 articles were selected for inclusion on the basis of their relevance to the objective and importance to and representation of ADHD research, including international guidelines for adults with ADHD.

**Results:** In a large proportion of children with ADHD, symptoms persist into adulthood. However, although adults with ADHD often experience chaotic lifestyles, with impaired educational and vocational achievement and higher risks of substance abuse and imprisonment, many remain undiagnosed and/or untreated. ADHD is usually accompanied by other psychiatric comorbidities (such as major depressive disorder, anxiety disorder, and alcohol abuse). Indeed, adults with ADHD are more likely to present to a psychiatric clinic for treatment of their comorbid disorders than for ADHD, and their ADHD symptoms are often mistaken for those of their comorbidities. Untreated ADHD in adults with psychiatric comorbidities leads to poor clinical and functional outcomes for the patient even if comorbidities are treated. Effective treatment of adults' ADHD improves symptoms, emotional lability, and patient functioning, often leading to favorable outcomes (eg, safer driving, reduced criminality). A few medications have now been approved for use in adults with ADHD, while a multimodal approach involving psychotherapy has also shown promising results.

**Conclusions:** General psychiatrists should familiarize themselves with the symptoms of ADHD in adults in order to diagnose and manage ADHD and comorbidities appropriately in these patients.

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Attention-deficit/hyperactivity disorder (ADHD) was, until recently, erroneously perceived as only present in young people, with little or no impact later in life.<sup>1,2</sup> In reality, ADHD can be an extremely debilitating neurodevelopmental disorder that often persists beyond childhood, perhaps in about one-third to two-thirds of patients.<sup>3,4</sup> Reports indicate that ADHD affects 2.5%–5% of adults in the general population,<sup>5–8</sup> compared with 5%–7% of children.<sup>9,10</sup> Interestingly, up to 40% of imprisoned men<sup>11</sup> and 17%–22% of adults attending psychiatric outpatient clinics for conditions other than ADHD suffer from the disorder.<sup>12–14</sup> However, fewer than 20% of adults with ADHD are currently diagnosed and/or treated by psychiatrists.<sup>7,15,16</sup> Some adults with ADHD will have received a diagnosis in childhood, although some will no longer be in contact with psychiatric services and will not have access to treatment (eg, during transition from child to adult health care practitioners).<sup>17</sup> Conversely, other adults will present with ADHD that was not diagnosed in childhood.<sup>12,14</sup>

Notably, ADHD is a highly inheritable disorder.<sup>18</sup> The disorder is reported to be at least 4-fold higher in parents of children with ADHD,<sup>19</sup> and, if at least 1 parent has ADHD, there is an increased risk of more severe ADHD symptoms in their children and an increased risk of family conflicts and negative parent-child interactions.<sup>20</sup> This strong link between ADHD in children and parents indicates the necessity to adopt a family perspective on ADHD. Preferably, parents should be asked whether they have symptoms of ADHD when their child is being assessed and should be offered a referral for evaluation when ADHD is indicated.

If left untreated in childhood or adulthood, the symptoms of ADHD (hyperactivity, inattention, and impulsiveness) can lead to behavioral, emotional, social, academic, and vocational problems.<sup>4,21,22</sup> Moreover, in adults, the debilitating nature of ADHD is compounded by common comorbid disorders (eg, major depressive disorder, anxiety disorder, substance use disorder, bipolar disorder, personality disorders). Indeed, symptoms of ADHD, such as mood instability or lability, inner tension, and restlessness, are often mistaken for comorbid disorders. This misdiagnosis, along with the lack of awareness of ADHD in adults, has led to the underdiagnosis of ADHD in these patients.<sup>16,23</sup> Hence, patients are more likely to be treated for comorbid disorders than for ADHD in psychiatric clinics.<sup>7</sup> Patients with ADHD can be effectively treated using a multimodal approach involving psychotherapy and an approved pharmacologic agent or pharmacotherapy alone,<sup>4,24–26</sup> even in the presence of some comorbid disorders (eg, anxiety, substance use disorder). Such treatments can benefit patients and wider society, for instance, as suggested by reduced criminality risk rates of 32%–41% in 25,656 patients treated with ADHD medications.<sup>27</sup> In addition, cotreatment of ADHD and comorbid disorders is also likely to result in improved outcomes compared with treating comorbid conditions without ADHD therapy.<sup>28</sup> General psychiatrists should therefore be familiar with the symptoms of ADHD in adults in order to foster recognition and management of ADHD and comorbid conditions in these patients.

- Attention-deficit/hyperactivity disorder (ADHD) is an underdiagnosed, undertreated, and often comorbid and debilitating condition in adults.
- Effective treatment of adult ADHD improves symptoms, emotional lability, and patient functioning, often leading to favorable outcomes, such as safer driving and reduced criminality.
- General psychiatrists should familiarize themselves with the symptoms of ADHD in adults in order to diagnose and manage ADHD and comorbidities appropriately in these patients.

In this review, we discuss the clinical presentation of adult psychiatric patients who may have underlying ADHD. We also describe the impact that ADHD and its common comorbid conditions has on adults with these disorders, including effects on society, particularly when ADHD is untreated or ineffectively treated.

## METHOD

The objective of this review is to raise awareness of ADHD as an underdiagnosed, undertreated, and often comorbid and debilitating condition in adults. PubMed was searched using combinations of keywords, including *ADHD*, *adult*, *diagnosis*, *identify*, *prevalence*, and *comorbid*, to find articles published between 1976 and 2013. In total, 99 articles were selected for inclusion on the basis of their relevance to the objective and importance to and representation of ADHD research, including international guidelines for adults with ADHD.

## Clinical Presentation of Adult Psychiatric Patients With ADHD

Attention-deficit/hyperactivity disorder begins in childhood and is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that leads to impairment in at least 2 areas of life.<sup>29</sup> However, while the symptoms of ADHD in adults are broadly similar to those found in children, there are crucial differences. For instance, hyperactivity and impulsiveness tend to decrease with age, more so than inattention,<sup>30</sup> while hyperactivity can develop into inner tension/restlessness,<sup>31,32</sup> leading to misdiagnoses of anxiety.<sup>32</sup> These differences are important, as applying *DSM-IV-TR* ADHD diagnostic criteria (originally developed for children) to assess ADHD in adults could lead to underdiagnoses in later life<sup>33</sup> and underestimated prevalence of ADHD in adults.<sup>6</sup> Hence, the developers of the new edition of the *DSM* (*DSM-5*; published in May 2013)<sup>29</sup> have adapted the criteria to better fit the need to diagnose ADHD in adults as follows:

1. While the 18 symptom criteria for ADHD are worded the same in the *DSM-5* as in the *DSM-IV-TR*, illustrative examples of how symptoms

typically present in older adolescents and adults have been included, thus facilitating the application of these criteria across the lifespan.

2. The diagnostic criteria continue to be grouped into the 2 symptom domains of inattention and hyperactivity-impulsivity. However, the previous categorization of ADHD into 3 subtypes (inattentive subtype, hyperactive-impulsive subtype, or the 2 combined)<sup>34</sup> has been replaced with directly corresponding presentation specifiers.
3. The symptom threshold of both inattention and hyperactivity-impulsivity criteria has been lowered for older adolescents and adults (aged 17 years and older) by requiring at least 5 of 9 criteria from either domain instead of 6 of 9 criteria. Solanto et al<sup>35</sup> demonstrated that lowering the symptom threshold of hyperactivity-impulsivity should aid identification of adults with ADHD.
4. In the *DSM-5*, contrary to the *DSM-IV-TR*, a comorbid disorder with autism spectrum disorder is no longer excluded. Indeed, studies report that both disorders tend to coexist.<sup>36,37</sup>
5. The age before which symptoms must be present has increased from before 7 years to before 12 years. This change is based on substantial research demonstrating that the course, severity, and outcome of the disorder and response to treatment are similar for children with symptoms recognized before the age of 7 versus those identified later in life.<sup>29,38</sup>

The increase in the age before which ADHD symptoms must be present is particularly important, given that adults with ADHD frequently fail to remember their behavior in preschool and early school years.<sup>39</sup> Moreover, as previously mentioned, ADHD is related to functional impairments in several areas of life. A functional impairment indicates that the available resources, comprised of internal resources (eg, ability to concentrate, remember, and not be impulsive) and external resources (eg, support from parents and teachers), are inadequate to meet the environmental demands (eg, academic, occupational, financial, and social functions) that tend to increase in number, scope, and complexity with increasing age and level of independence.<sup>3</sup> As the numbers and levels of internal and external resources differ between individuals, functional impairments will emerge at different timepoints; some patients will demonstrate impairments early in childhood, whereas impairments may not emerge in others until later in life.<sup>3</sup>

In addition to the *DSM* criteria, the *ICD-10* guidelines are often used to classify diseases in Europe.<sup>40</sup> However, the *ICD-10* classifications are not as widely used as the *DSM* for the diagnosis of ADHD because the signs of ADHD are not specifically defined in the *ICD-10* but are grouped with other “hyperkinetic disorders.”

To briefly screen for the presence of ADHD in adults, the following 4 yes/no questions have been suggested by Kooij<sup>41</sup>:

1. Do you usually feel restless (eg, nervous, difficulty sitting still, fidgeting, a lot of exercising or being active)?
2. Do you usually act first and then think (eg, blurting things out, spending too much money, or being impatient)?
3. Do you usually have concentration problems (eg, being easily distracted, not finishing things, being easily bored, forgetful, or chaotic)?

If the answer to questions 1 and/or 2 and/or 3 is yes:

4. Have you always had this? (as long as you can remember, or have you been like this most of your life).

If the answer to question 4 is yes, consider further diagnostic assessment for ADHD.

Alternatively, the Adult ADHD Self-Report Scale<sup>42</sup> (for symptoms of ADHD that are present in adulthood) could be used to screen for suspected cases of ADHD, in conjunction with the Wender Utah Rating Scale<sup>43</sup> (WURS; for childhood symptoms of ADHD),<sup>11,14</sup> as current criteria for the diagnosis of ADHD require symptoms to be present in childhood. However, it has to be stressed that screening questionnaires are not diagnostic tools. A diagnosis of ADHD in adults can be gained using diagnostic interviews such as the Brown Attention-Deficit Disorder Scale (BADDS) diagnostic form,<sup>44</sup> the Adult ADHD Clinical Diagnostic Scale (ACDS),<sup>45</sup> the Conners' Adult ADHD Diagnostic Interview for *DSM-IV* (CAADID),<sup>46</sup> or the structured Diagnostic Interview for ADHD in Adults (DIVA 2.0).<sup>47</sup> The DIVA 2.0 is based on the same *DSM-IV* criteria as the CAADID, thus the 2 interviews are similar. In fact, the DIVA 2.0 was developed and translated by members of the European Network Adult ADHD because of the "need for a structured diagnostic instrument in the field that is easily available at low costs, in many different languages."<sup>47</sup> The DIVA 2.0 is available at <http://www.divacenter.eu/DIVA.aspx>.

Underrecognition of ADHD in adults is, at least in part, likely to be due to the mistaken belief that ADHD does not persist into adulthood, as well as uncertainty about diagnostic criteria in adults and the belief that ADHD is less severe than other comorbid disorders.<sup>31</sup> This underrecognition leads to adults being treated for their psychiatric comorbidities rather than the ADHD, which may be the patient's main problem that predisposes them to other psychiatric disorders.<sup>31</sup> Indeed, Nylander et al<sup>13</sup> used the WURS, followed by other psychiatric and neuropsychological assessments, to demonstrate the high prevalence of psychiatric comorbidities (most commonly affective disorders) and alcohol/substance abuse with previously undiagnosed ADHD in a group of 141 adult patients attending a general psychiatric clinic. Of these patients, at least 31 (22%) had ADHD, and only 6 of those patients had previously been diagnosed with the disorder on the basis of childhood ADHD criteria. Similar data were also recorded by Almeida Montes et al<sup>12</sup> and Rao and Place<sup>14</sup> in adults diagnosed with ADHD who had not been diagnosed with the disorder in childhood.

Traditionally, ADHD is thought to be more common in boys than girls (estimated ratios range between 2:1 and 9:1).<sup>48</sup> However, the prevalence of ADHD by gender is currently unclear in adults. In one Hungarian study of 3,529 patients attending general practitioner practices,<sup>49</sup> while ADHD was more prevalent in men (~3.5%) than women (~1.1%) in the ≤40 years age group, the prevalence of ADHD was similar for each gender in the >40 years age group (<1% for men and women). Moreover, higher proportions of women than men attending psychiatric clinics as outpatients for conditions other than ADHD were diagnosed with ADHD in studies by Almeida Montes et al<sup>12</sup> (21.6% vs 8.5%, respectively) and Nylander et al<sup>13</sup> (48% vs 23%, respectively). As stated by Almeida Montes et al<sup>12</sup> and Nylander et al,<sup>13</sup> their prevalence data may have been confounded by variables that can occur in clinical practice. For instance, Almeida Montes and colleagues<sup>12</sup> suggested that the gender imbalance in their study may have been due to a reference bias of more women entering psychiatric consultation than men. Indeed, Almeida Montes and colleagues<sup>12</sup> noted that the main reasons for psychiatric consultation in their sample were anxiety and depressive disorders, which have previously been detected in higher proportions of women with ADHD than in men with ADHD.<sup>50,51</sup> Similarly, Nylander et al<sup>13</sup> postulated that their gender imbalance could result from the possibility that (1) "a number of men with ADHD or ADHD-like symptoms are clients of other types of services (eg, treatment centers for offenders or services for alcohol or substance dependence rather than outpatients of psychiatric clinics)" and (2) "women are more prone to give information on ADHD-like symptoms or more often suffer from disorders (eg, depression or borderline personality disorder) that have been observed to also give high scores on the WURS."<sup>(p68)</sup>

Another possible reason for higher rates of women recognized with ADHD in adult psychiatric patients could be related to a clinic referral bias during childhood, when boys with ADHD are more likely to be referred than girls, despite girls being as functionally impaired as boys when compared with non-ADHD boys and non-ADHD girls.<sup>52</sup> In clinic-referred samples, girls with ADHD present with less aggression and other disruptive behaviors but more internalizing problems of depression and anxiety (especially in adolescence) than boys with ADHD.<sup>52</sup> Thus, underdiagnosis of ADHD in girls may lead to a higher number of women than men being diagnosed in adulthood, relative to childhood.

### The Impact of ADHD During Adulthood

Almost every aspect of adult life can be impacted by ADHD, including work and family life, particularly if the condition remains undiagnosed, untreated, or ineffectively treated, potentially with a detrimental effect on psychological well-being and quality of life. Conversely, some adults with ADHD may appear to function normally, although they might expend excessive amounts of energy trying to overcome their impairments; this may also affect their psychological well-being, as patients are distressed by persistent symptoms such as restlessness and mood instability.<sup>53</sup>

**ADHD: educational and vocational underachievement.** Multiple studies demonstrate that adults with ADHD often suffer from educational underachievement, thus ADHD is significantly more prevalent among adults with low rather than high educational levels.<sup>4,54-56</sup> Similarly, patients with ADHD tend to find it more difficult to gain and maintain employment<sup>4,22</sup>; tend to be less productive in work than controls due to poor time management, procrastination, distractibility, and a greater number of lost work days<sup>57</sup>; and show disability in social role functioning.<sup>7</sup> The symptoms of ADHD can therefore translate into significant financial costs for employees with ADHD and their employers. Unsurprisingly, household incomes for adults with ADHD are lower compared with those of controls.<sup>56,58</sup> For instance, in one US study, the mean annual income was \$41,511 in households inhabited by adults with ADHD (n = 500) versus \$52,053 for controls (n = 501) (\$33,518 vs \$54,148, respectively, for 25-34 year olds).<sup>56</sup>

The symptoms of inattentiveness that may affect educational and vocational attainment include difficulty focusing on and completing tasks, making careless mistakes, poor organizational and listening skills, and being easily distracted and forgetful. These patients may also become easily frustrated and may not be able to control their emotions and impulses effectively.<sup>27,59</sup> In addition, hyperactivity may result in ADHD patients working multiple jobs, working long hours, or working in a very active job that is commensurate with the need for stimulating activity, motion, and change.<sup>60</sup> Similarly, impulsiveness may manifest in frequent job changes without considering the long-term future.<sup>60</sup>

**ADHD: family life and relationships.** The symptoms of ADHD, including poor listening skills, a tendency to interrupt others, and being constantly active and easily frustrated, can lead to tensions not only with work colleagues, but also in relationships with family members, friends, and partners. It is postulated that the impulsive and oppositional interpersonal style of people with ADHD may inhibit social interaction with friends and colleagues.<sup>55</sup> For example, young women with ADHD in one longitudinal study experienced more conflict with their mothers, were involved in fewer romantic relationships, and experienced more depressive symptoms than matched controls.<sup>55</sup> These patients were also more likely to internalize problems and have low self-esteem.

**ADHD: antisocial behavior, substance use disorder, criminality, and imprisonment.** A disorder that is strongly associated with ADHD in childhood is oppositional defiant disorder.<sup>61,62</sup> Oppositional defiant disorder manifests as negative, hostile, and defiant behavior directed at authority figures<sup>61-63</sup> and often precedes conduct disorder.<sup>63</sup> In turn, conduct disorder may also be a precursor to antisocial personality disorder.<sup>64</sup> Antisocial personality disorder may be prevalent in adults with ADHD; Mannuzza et al<sup>65</sup> reported that antisocial personality disorders were found in around 18% of 91 young men who also had ADHD. However, controversy exists as to whether ADHD by itself is a risk factor for antisocial behavior and delinquency, or

whether this is mediated by comorbid disruptive symptoms of oppositional defiant disorder and/or conduct disorder, or whether the oppositional symptoms associated with oppositional defiant disorder and conduct disorder are components of ADHD.<sup>62</sup>

Nevertheless, ADHD alongside oppositional symptoms of oppositional defiant disorder and conduct disorder is associated with an increased risk of substance use disorder.<sup>61,63</sup> In a meta-analysis of 29 studies, ADHD was present among 23% of adolescents and adults with various substance use disorders (excluding nicotine dependence).<sup>66</sup> ADHD also appears to have a negative impact on the course of substance use disorder; patients with ADHD experience substance use disorder earlier, become addicted more easily, have lower remission rates, and are hospitalized more often, relative to people without ADHD who have substance use disorder.<sup>67,68</sup>

Also, ADHD coexistent with substance use disorder and antisocial personality disorder is a major risk factor for criminal offending.<sup>69</sup> Indeed, high rates of imprisonment, delinquency, and substance use disorder are linked to adolescents and adults with ADHD.<sup>11,23,51,70,71</sup> In one study of 198 prison inmates, those with child or adult ADHD symptoms were more likely to have committed violent crimes, use heroin, and be dependent on alcohol than other prisoners.<sup>71</sup> However, ADHD is not usually identified or treated in prisoners.<sup>11,72</sup> Furthermore, prison inmates with ADHD are more difficult and costly to manage and rehabilitate than other inmates, related to their earlier onset of offending, increased criminal recidivism, and more severe intrainstitutional aggression.<sup>73,74</sup> Interestingly, a large study (25,656 patients) found lower rates of criminality when patients were receiving treatment for their ADHD. Thus, the authors stated that “these findings raise the possibility that the use of medication reduces the risk of criminality among patients with ADHD.”<sup>27(p2006)</sup>

**ADHD: potential impact on driving.** When driving a vehicle, adults with ADHD are at higher risk of collisions, speeding, violations, and risky behavior relative to drivers without ADHD.<sup>75,76</sup> However, these risks can be reduced using pharmacologic treatments and nonpharmacologic strategies (eg, hazard perception training).<sup>75,77,78</sup> Hence, as concluded by Jerome et al,<sup>79</sup> “The individual attending physician has an opportunity to reduce morbidity and mortality for the individual ADHD patient, as well as to contribute to improved public health for the driving population at large by making the roads safer one driver at a time.”<sup>(p424)</sup>

### Comorbid Conditions

Other clinical complications usually accompany ADHD, with as many as 90% of adults with ADHD having comorbid psychiatric disorders.<sup>17</sup> These associations hold up even when careful diagnoses involve adjustment for overlap of symptoms, imprecision of diagnostic criteria, or other methodological confounds.<sup>80</sup> In addition, the combined symptom presentation of ADHD is more often associated with comorbid disorders than the predominantly inattentive presentation.<sup>81</sup>

It is possible that strong associations between ADHD and some comorbid conditions have a genetic basis. As mentioned previously, ADHD is a highly inheritable disorder, which is considered to be polygenic. At least 50 genes have been implicated in ADHD, including those encoding enzymes of neurotransmitter metabolism and neurotransmitter transporters and receptors.<sup>82</sup> Many of these candidate genes are not unique to ADHD but have also been linked to other psychiatric disorders.<sup>83</sup> Thus, shared pathophysiology may explain the frequent comorbidity of ADHD with other conditions.

**Comorbid psychiatric disorders.** Comorbid psychiatric disorders may impact ADHD patients' compliance and response to treatment.<sup>16</sup> However, better clinical outcomes could be gained by treating ADHD in adults, as opposed to solely treating the comorbid conditions.

Several clinical psychiatric disorders and personality disorders are often found to be comorbid with ADHD. Psychiatric disorders associated with ADHD include depression, dysthymia, anxiety disorders (eg, generalized anxiety disorder, social phobia, specific phobias, and panic disorder), substance use disorder including nicotine dependence, and eating disorders (eg, bulimia).<sup>12,21,84-86</sup> The most commonly reported personality disorders in patients with ADHD were antisocial personality disorder, borderline personality disorder, and histrionic traits.<sup>12,21,53,87</sup> Similarly, adults with borderline personality disorder may frequently have comorbid ADHD and/or a history of ADHD in childhood. Philipsen et al<sup>88</sup> demonstrated that, of 118 adults with borderline personality disorder, 16.1% simultaneously had ADHD and 41.5% had a history of ADHD symptoms in childhood. In addition, studies report that ADHD and autism spectrum disorder frequently coexist, with ADHD present in 30%–80% of patients with autism spectrum disorder and autism spectrum disorder present in 20%–50% of patients with ADHD.<sup>36</sup> When ADHD and autism spectrum disorder coexist, individuals are reported to be more severely impaired compared with those with ADHD or autism spectrum disorder alone.<sup>37</sup>

**Other comorbidities.** Adults with ADHD have increased risk not only of other psychiatric disorders but also of physical disorders; for instance, they are at increased risk of obesity. In 2 North American studies (Pagoto et al<sup>89</sup> and Levy et al<sup>90</sup>), 19 of 63 adults (30%) and 78 of 242 adults (32%) presenting to a clinic for weight loss treatment also had ADHD. Interestingly, in the study by Levy et al,<sup>90</sup> weight change (–12%) was statistically significantly different after 466 days of ADHD pharmacotherapy in obese adults diagnosed with ADHD, relative to obese untreated controls who also had ADHD (+3%). The reduction in weight was said to occur synchronously with relief of ADHD symptoms.<sup>90</sup> Indeed, it has been suggested that inattention may be related to poor adherence to goal-directed dietary and physical activity behaviors, and impulsive people may be prone to overeating.<sup>91</sup> As obesity affects a large proportion of people in Western countries (eg, almost one-third of adults in the United States<sup>92</sup>), diagnosing and

treating ADHD in this population may have a huge impact on overall health.

In addition, ADHD has also been associated with sleep impairments, as shown by Surman et al<sup>93</sup> in 182 adult patients with ADHD. In another study of 148 college students, daytime sleepiness and sleep disruption correlated with inattentiveness and hyperactivity.<sup>94</sup> Hence, Surman et al<sup>93</sup> stated that clinicians should “take care to evaluate adults with ADHD for clinically significant sleep impairment and comorbid sleep disorders.”<sup>(p1,528)</sup>

Furthermore, 2 recent studies by the same research group suggest that associations may also exist between ADHD and asthma<sup>95</sup> and ADHD and migraines.<sup>96</sup> Comorbidity between asthma and ADHD was based on a population of 18,481 patients who were prescribed anti-ADHD drugs; 1,730 of these patients were also prescribed antiasthma drugs, which equates to a 65% higher overall risk of being prescribed anti-ADHD drugs compared with controls.<sup>95</sup> In another report, the researchers presented evidence for an association between the presence of migraines and ADHD in adults in which 572 patients with ADHD responded to questionnaires, demonstrating a prevalence of migraines in 28.3% of patients compared with 19.2% of controls.<sup>96</sup> However, it is notable that there was a higher frequency of depression and/or anxiety in ADHD patients with migraine versus ADHD patients without migraine, and bipolar disorder was higher in male ADHD patients with migraine. The authors of this cross-sectional study postulated that the association between ADHD, migraine, and bipolar disorder may be due to common underlying pathophysiologic mechanisms, such as alterations in dopaminergic systems, which is a focus of pathophysiologic research in ADHD, migraine, and mood disorders.<sup>96</sup>

**The economic burden of adults with ADHD and comorbidities.** As previously mentioned, adults with ADHD are more likely than controls to have worse job prospects and lower financial income.<sup>4,22,56,58</sup> Also, adults with ADHD use medical services 50% more than controls; thus, this ADHD will have an economic impact in addition to costs associated with treatment.<sup>97</sup> Reasons for greater use of medical services include increased number of accidents (adolescents and young adults experience more traffic accidents than those without ADHD)<sup>76,98</sup> and unhealthy lifestyles (smoking, alcohol and drug abuse, risky sexual activity).<sup>31</sup> Similarly, untreated ADHD in adults also results in higher costs due to sick leave and lower productivity compared with controls.<sup>31</sup>

In addition, undiagnosed and untreated ADHD is likely to lead to suboptimal outcomes of certain comorbid conditions, such as substance use disorder, personality disorder, mood instability,<sup>31</sup> and obesity,<sup>90</sup> and thus potentially to higher costs than if ADHD and comorbid conditions were treated separately. Indeed, Newcorn et al<sup>16</sup> asserted that it is difficult to effectively treat ADHD without evaluating comorbidity and vice versa, and it is cost-effective to screen for comorbid disorders when assessing ADHD and vice versa, as comorbid disorders could negatively impact ADHD outcomes (by affecting treatment compliance, persistence, and response). Accordingly, diagnosis and effective management of adults'

ADHD and comorbidities should lead to more efficient use of health services, better clinical outcomes, and a lower financial burden on ADHD patients and on society in general due to reduced use of medical resources and improved work productivity. Indeed, a German health technology assessment concluded that treatment of adults with ADHD, using atomoxetine, methylphenidate, or dextroamphetamine (which are approved ADHD treatments in various countries, including the United States and some European countries), is not just clinically important, but is also recommended for health economic reasons.<sup>99</sup>

## CONCLUSIONS

While ADHD is a common and treatable disorder, it is underdiagnosed in adults. The disorder often has a major effect on patients' lifestyles, well-being, and quality of life, including negatively impacting their social, family, and working lives, and when combined with conduct disorder, ADHD is strongly linked with substance use disorder and delinquency. Moreover, ADHD is a risk factor for conditions such as major depressive disorder, anxiety, personality disorders, and bipolar disorder; thus, adults with undiagnosed ADHD often seek help for their comorbid condition instead of ADHD. Increased awareness of ADHD symptoms and increased use of diagnostic tools are needed in general psychiatric practice to identify the disorder in adults and help these patients in coping with their ongoing difficulties throughout their lifetimes. Better clinical outcomes can be achieved by treating adults with ADHD with a targeted and evidence-based approach using approved ADHD therapies than by solely treating comorbid conditions.

**Drug names:** atomoxetine (Strattera), methylphenidate (Focalin, Daytrana, and others).

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