Symptoms of ADHD are highly common in undiagnosed adults – A cross-sectional study in a large population of Danes

Louise K Hoeffding; Maria Haahr Nielsen; Janna Nissen; Maria Didriksen; Thomas Werge; Trine Schow; Christian Eriksen; Ole Birger Pedersen; Henrik Hjalgrim; Jens RM Jepsen; Henrik Ullum; Kristoffer Burgdorf

1Department of Clinical Immunology, University Hospital of Copenhagen, Denmark
2Institute of Biological Psychiatry, Copenhagen University Hospital, Denmark
3The Lundbeck Foundation Initiative for Integrative Psychiatric Research, Denmark
4The Brain Injury Center, Denmark
5Department of Clinical Immunology, Aarhus University Hospital, Denmark
6Department of Clinical Immunology, Næstved Hospital, Denmark
7Department of Epidemiology Research, Statens Serum Institute, Denmark
8Department of Hematology, Copenhagen University Hospital, Denmark
9Child and Adolescent Mental Health Centre, Mental Health Services in the Capital Region of Denmark
10Lundbeck Foundation Center for Clinical Intervention and Neuropsychiatric SchizophreniaResearch (CINS), Psychiatric Center Glostrup, Denmark

*Corresponding Author(s): Kristoffer Burgdorf,
Department of Clinical Immunology, Rigshospitalet,
Blegdamsvej 9, DK-2100 Copenhagen Ø, Denmark
Tel: +45 3545 3324
Email: Kristoffer.soelvsten.burgdorf@regionh.dk

*Equal Contribution: Louise K Hoeffding & Maria Haahr Nielsen equally contributed to this work

Received: Feb 28, 2018
Accepted: May 11, 2018
Published Online: May 17, 2018
Journal: Journal of Psychiatry and Behavioral Sciences
Publisher: MedDocs Publishers LLC
Online edition: http://meddocsonline.org/
Copyright: © Burgdorf K (2018). This Article is distributed under the terms of Creative Commons Attribution 4.0 International License

Keywords: ADHD; ASRS; Public mental health; Behavior

Abstract

Objective: The prevalence of Attention-Deficit/Hyperactivity Disorder (ADHD) among adults is well established in the general population. So far no studies have addressed the prevalence of ADHD symptoms in otherwise healthy individuals. The aim of the present study is to characterize the distribution of self-reported ADHD symptoms and ADHD subtypes across sex and age intervals in healthy Danes.

Methods: A total of 26,217 individuals (aged 18-67 years) who completed the Adult ADHD Self-Report Scale V1.1 (ASRS) were included in the study population. We used logistic regression to assess the association of age and sex with positive ADHD screens across three different ASRS scoring methods.

Results: The prevalence of ADHD in the study population was 1.1-2.7% depending on the applied ASRS scoring method. ADHD symptoms decreased with increased donor age.

Conclusion: Severe symptoms of ADHD are not uncommon among undiagnosed individuals. The prevalence of self-reported ADHD varied by the applied scoring method of ASRS.

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD), with the core symptoms in attention, hyperactivity, and impulsiveness, is the most common psychiatric disorder among children and adolescents. Previously, ADHD was assumed to be a childhood behavioral disorder, however, several follow-up studies indicate that 50-78% of children diagnosed with ADHD continue to have the symptoms in adulthood [1–5]. In addition, individuals with late-onset ADHD have been described suggesting that ADHD can develop across the entire lifespan [2,6–8].

Reported estimates of ADHD prevalence vary markedly, primarily because of methodological differences across studies. The worldwide pooled prevalence of ADHD among children and adolescents has been estimated to be 5.3% [9] while more recent meta-analyses have suggested a slightly higher prevalence (~7%) [10,11]. In contrast, the average prevalence of ADHD in the general adult population is between 1.1-5% [12-14] but these estimates might be grossly underestimated and suffer from ascertainment biases related to the high number of unrecognized and inaccurately diagnosed adults [12,15-17]. None-the-less, both symptoms related to inattention and hyperactivity have been shown to be rather common (~60%) in the general population which underline that ADHD symptoms form a continuum [18].

It is generally accepted that ADHD symptoms manifest differently between genders and that boys are more often affected than girls [19–23]. However, this gender-discrepancy varies across ADHD subtypes and tends to level off into adulthood where men and women are almost equally affected [12,24–26]. This shift in sex ratio towards similar prevalence’s may reflect that young girls primarily are affected by the often undetected inattention subtype [27-29]. In addition to gender, follow-up studies have suggested that ADHD symptomatology differs over time and in particular changes during adolescence. In adulthood, the hyperactivity-impulsiveness subtypes of ADHD often become less apparent whereas the inattention subtype seems to persist [1,3,17,30–33]. This lack in symptom profile stability during life has called for more adult-specific diagnostic criteria for ADHD subtypes [34].

One of the most commonly used ADHD screening instruments in adults is the Adult ADHD Self-Report Scale V1.1 (ASRS) developed by the working group of adult ADHD for the World Health Organization (WHO) [35]. The ASRS consists of an 18-item scale evaluating the dimensions of inattention and hyperactivity-impulsiveness subtypes of ADHD in adults. Multiple published studies find that the ASRS is a reliable and valid instrument for screening for ADHD symptoms in adults in clinical and community samples [36,37]. Since the ASRS is designed for unsupervised self-reporting of ADHD symptoms and, in addition, is both time-efficient and cost-effective it has been widely used in large scale studies [12,14,37-41]. The use of different scoring methods and cut-off values of the ASRS in the literature has been controversial [35-37]. The most widely used diversion of the ASRS is the fast 6-items ASRS screener that was originally extracted by stepwise logistic regression from the full 18-item ASRS scale [35]. The 6-item ASRS screener has been shown to outperform the 18-items ASRS with respect to sensitivity, specificity, and accuracy [37]. Two alternative ASRS scoring methods have, in addition, been used which either assess the total sum score of all 18 items (with a predefined cut-off value) or a separation of the 18-items into two subscales - with nine items each - evaluating either symptoms of inattention or hyperactivity-impulsiveness corresponding to the DSM-IV symptoms of ADHD [35-37].

Aims of the study

The aim of the study is to estimate the prevalence of self-reported ADHD symptoms in healthy adults from the Danish Blood Donor Study. Since several scoring methods of the ASRS exist, we here used the three most commonly reported scoring methods in the literature in order to compare estimates within the study population and across studies. We examine the sex and age related variations in self-reported ADHD symptoms and subtypes.

Materials and methods

Study population

A total of 27,315 participants were included in the present study. Data were collected between May 1,2015 and February 1, 2017 as part of the Danish Blood Donor Study (DBDS; www.dbds.dk) [42,43]. In brief, the DBDS is an ongoing multicenter, population-based study and biobank initiated in 2010. To date, more than 110,000 voluntary blood donors from blood banks across Denmark have been included. Preliminary data suggest a response rate of 95% among invited blood donors [42]. All participants are between 18 and 67 years of age, are generally healthy and un-medicated [44]. At enrollment, oral and written informed consent is obtained from all participants and a digital tablet-based questionnaire including the ASRS is completed [43].

The Danish Data Protection Agency (2007-58-0015) and the Ethical Committee of Central Denmark (M-20090237) have approved the study.

Of the 27,315 participants included in the present study, 27,217 (96.0%) completed all 18 items of the full edition of ASRS. The remaining 1,098 individuals were excluded from the study population due to missing ASRS scores. These 1,098 individuals did not differ with respect to sex (P=0.5) but were significantly older (median age: 51.1 years) compared to the remaining study population (median age: 41.6 years) (Mann-Whitney U test, P<0.00001).

Adult ADHD self-reported scale

Self-reported ADHD symptoms in this study population were evaluated by the V1.1 ASRS full edition [35] adapted to Danish [45]. It consists of 18 symptom items based on the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM IV; American Psychiatric Association [APA], 1994) of which the first six items are the most predictive of ADHD symptoms and forms the short ASRS screener [37]. The ASRS full edition consists of nine items that represent symptoms related to inattention (items 1-4 and 7-11), and nine items assessing symptoms of hyperactivity-impulsiveness (items 5-6 and 12-18). Each of the items is scored on a five-point Likert rating scale with 0=“never”, 1=“rarely”, 2=“sometimes”, 3=“often”, and 4=“very often” based on the participant’s experiences over the last 6 months. Thus, a high score indicates a greater severity of self-reported ADHD symptoms. While the ASRS has not been validated in a Danish setting, it is a widely used and valid screening instrument regarding ADHD symptoms in adults and has shown good reliability and diagnostic utility among adolescent and adults [36,37,46-48] also in Scandinavian [49]. A more detailed description of the ASRS questionnaire can be found elsewhere [35].

Journal of Psychiatry and Behavioral Sciences
Scoring of ASRS

As originally suggested by Kessler et al. [35,37], different scoring methods can be used to assess self-reported ADHD symptoms using ASRS. In this study, we used the following three different approaches (Table 1): (1) The first approach (referred to as “ASRS 6-items screener”) involves summing the scores of the first six items of the ASRS full edition (range: 0-24). Sum scores ≥14 indicate a positive screening result. (2) The second approach (referred to as “ASRS full edition”) addresses ADHD symptoms on the 18-items ASRS fulledition (range: 0-72). Total sum scores ≥37 corresponds to a positive screening result. (3) The third approach (referred to as “inattention/impulsiveness subscale”) is based on the nine items per subscale (range: 0-36) related to either the inattention or hyperactivity-impulsiveness items. All individuals with a full eduction score on either subscales of ≥24 were considered to have a positive screening result for ADHD.

The comparison group consisted of the remaining individuals from the study population with ASRS scores below the pre-defined cut-off values described in Table 1.

Statistical analysis

Descriptive statistics of the three ASRS scoring methods (below or above the predefined cut-off values) are for categorical variables presented as number and percentage and for continuous variables as median with Interquartile Range (IQR). Age of each participant was calculated at the time of completed ASRS-questionnaire and categorized as ≤25, 26-30, 31-35, 36-40, 41-45, 46-50, and >50 years.

Logistic regression analysis was used to assess the effect of age and sex on the presence of self-reported ADHD symptoms across the different ASRS scoring methods. Here, the age groups >50 years was set as the reference group. In addition, an analysis that adjusted for sex was performed. Odds Ratios (OR) with 95% confidence Intervals (CI) are presented and P<0.05 were considered statistical significant. Data analysis was conducted using the statistical program STATA 13.1 (StataCorp, college station, Texas, USA).

Results

In total, 26,217 individuals (median age (IQR): 41.6 (29.9-51.7) years) from the DBDS completed the ASRS full edition were 54.2% were males (median age (IQR): 42.1 (31.3-51.9) years)and 45.8% were females (median age (IQR): 40.9 (28.2-51.4) years).

Table 1 shows the number of individuals who either screened positive or negative for ADHD using the three alternative scoring methods for the ASRS (the ASRS 6-item screener (median mean age (IQR): 31.2 (25.3-39.1) years versus 41.9 (30.1-51.8) years, respectively), the ASRS full edition (median age (IQR): 30.5(25.2-40.5) years versus 41.9 (30.2-51.9) years, respectively), and the inattention/hyperactivity-impulsiveness subscales (median age (IQR): 30.5 (25.2-40.2) years versus 41.7 (30.0-51.8) years, respectively), see methods for further details). According to standard cut-offs for the ASRS 6-items screener, 2.1% (95% CI: 2.0 to 2.3) of the study population scored ≥14 and thereby screened positive for adult ADHD. When using either the ASRS full edition or the inattention/hyperactivity-impulsiveness subscales scoring method, 2.6% (95% CI: 2.4 to 2.8) and 1.1% (95% CI: 0.9 to 1.2), respectively screened positive for ADHD in our study population (Table 2).
thereby illustrates that even in a healthy population of blood donors a considerable number of individuals have a score above the threshold for possible having the ADHD syndrome. Our prevalence estimates are similar to those previously reported [12–14,50], and supports the need for a targeted approach towards ADHD diagnosis in adults in general.

Several aspects of our study merit further discussion. First, there was only minor overlap of individuals screening positive for ADHD with the three most widely used ASRS scoring methods (35,37) (Table 2 and Figure 1). These discrepancies illustrate how critical the ASRS scoring methods are to the identification of individuals potentially suffering from ADHD, which subsequently influence the prevalence estimates of these screening results. Hence, our study highlights the need for a better understanding of the underlying differences between the ASRS scoring methods, and suggests that the ASRS screening scale should be used with caution and never replaces a clinical examination using golden standard evaluations. Whether the discrepancies between scoring methods are specific to the Danish translation of the ASRS and the blood donor population is not known, however, the Swedish translation of ASRS has shown promising psychometric properties in an population of adolescents with ADHD [49].

Secondly, it is widely accepted that the sex differences of ADHD becomes less prevalent with age [12,24–26,50]. In our study population, statistically significant sex-specific variation in the ADHD prevalence was observed for the ASRS 6-item screener (Table 1). This could reflect a more positive response style among male than female blood donors on the 6-item ASRS screener, or suggest that the 6-item ASRS screener exclude important information related to sex that is included in the remaining 12 items.

Thirdly, in line with previous published results [1,3,17,30-33], we found that the inattention ADHD subtype was more prevalent that the hyperactivity-impulsiveness subtype. This was as expected that adult who suffer from hyperactivity and impulsiveness are less inclined to become blood donors (Figure 2). Further stratifying the inattention or hyperactivity-impulsiveness ADHD subtypes by sex and age, we found that the prevalence of both the inattention and hyperactivity-impulsiveness subtypes decreased with increased age. This suggests that - in contrast to cross-sectional studies - the inattention subtype does not tend to persist during life for either male or female blood donors or the 6-item ASRS screener, or suggest that the 6-item ASRS screener exclude important information related to sex that is included in the remaining 12 items.

Finally, either pregnant or lactating females are allowed to donate blood and are therefore not included in the DBDS. This could result in non-random sex differences especially for the childbearing ages included in the study. However, since there are no significant differences in age between males and females in the study population this bias might be less important.

This study is the first to evaluate self-reported ADHD symptoms using the ASRS in an adult population of 26,217 healthy Danish blood donors. By the use of three alternative ASRS scoring methods, 1.1% to 2.6% of the blood donors screened positive for ADHD, indicating that the prevalence of self-reported ADHD symptoms are highly dependent on the applied ASRA scoring method and needs to be validated for ADHD assessment.

**Acknowledgment**

We acknowledge the Danish blood donors and the staff at the Danish blood banks that were involved in the present study. This work was supported by the Lundbeck foundation, Denmark under Grant (R219-2016-1030 to Dr. Høffding); The Danish Council for Independent Research - Medical Sciences under Grant (1333-00275A to Dr. Burgdorf and 09-069412); The Danish Administrative Regions; The Danish Administrative Regions’ Bio- and Genome Bank; and The Danish Blood Donor Research Foundation (Bloddonorernes Forskningsfond). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
Figures

**Figure 1:** Number of individuals with a positive ADHD screen according to the ASRS 6-items screener, the ASRS full edition, and the inattention/hyperactivity-impulsiveness subscale (IN/HY-IM) cut-off values, respectively among the 26,217 individuals from DBDS. The number of individuals with a positive ADHD screen according to the three alternative scoring methods of the ASRS in DBDS (N=26,217) (see method for details regarding the different scoring methods).

**Figure 2:** ADHD subtypes stratified by sex based on the inattention/hyperactivity-impulsiveness subscale scoring method of the ASRS. The figure illustrates the number of males and females (N=291) with an ASRS score ≥24 on either the inattention or hyperactivity-impulsiveness subscale. The same individual will appear in more than one group due to the combined subtype of ADHD (score ≥24 on both the inattention and hyperactivity-impulsiveness subscale).

**Figure 3:** Age range of the inattention and hyperactivity-impulsiveness subtypes of ADHD using the inattention/hyperactivity-impulsiveness subscale scoring method of the ASRS. Age range for males and females with either the inattention (left figure) or the hyperactivity-impulsiveness (right figure) subtypes of self-reported ADHD symptoms illustrated as the percentage of the total number of individuals with a positive ADHD screen on either subscales. Here, individuals with the combined subtype (inattention and hyperactivity-impulsiveness) of ADHD will appear in both the inattention and the hyperactivity-impulsiveness analysis.

Tables

**Table 1:** Differences between individuals screening positive and negative for ADHD among individuals in the DBDS according to the three alternative scoring methods of the ASRS and their respective cut-off value.

<table>
<thead>
<tr>
<th>Scoring method</th>
<th>ASRS 6-items screener</th>
<th>ASRS full edition</th>
<th>Inattention/hyperactivity-impulsiveness subscale</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut-off</td>
<td>≥14</td>
<td>≥37</td>
<td>≥24</td>
<td></td>
</tr>
<tr>
<td>Items</td>
<td>1-6</td>
<td>1-18</td>
<td>1-4+7.1/5-6+12-18</td>
<td></td>
</tr>
<tr>
<td>ADHD</td>
<td>557 (2.1)</td>
<td>690 (2.6)</td>
<td>291 (1.1)</td>
<td>25,926 (98.9)</td>
</tr>
<tr>
<td>No ADHD</td>
<td>25,660 (97.9)</td>
<td>25,527 (97.4)</td>
<td>25,926 (98.9)</td>
<td>26,217 (100)</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>380 (2.7)</td>
<td>385 (2.7)</td>
<td>160 (1.1)</td>
<td>14,048 (98.9)</td>
</tr>
<tr>
<td></td>
<td>(97.3)</td>
<td>(97.3)</td>
<td>(1.1)</td>
<td>(54.2)</td>
</tr>
<tr>
<td>Female</td>
<td>177 (2.7)</td>
<td>130 (2.7)</td>
<td>131 (1.1)</td>
<td>14,179 (99.9)</td>
</tr>
<tr>
<td></td>
<td>(97.3)</td>
<td>(97.3)</td>
<td>(1.1)</td>
<td>(45.8)</td>
</tr>
</tbody>
</table>
### Table 2: Odds ratios and 95% confidence intervals across different age ranges among blood donors screening positive for ADHD when compared to individuals screening negative for ADHD in the DBDS.

<table>
<thead>
<tr>
<th>Age in years (%)</th>
<th>ASRS 6-items screener OR (95% CI)</th>
<th>Adjusted for sex OR (95% CI)</th>
<th>ASRS full edition OR (95% CI)</th>
<th>Adjusted for sex OR (95% CI)</th>
<th>Inattention/hyperactivity-impulsiveness subscale OR (95% CI)</th>
<th>Adjusted for sex OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤25</td>
<td>8.5 (6.0-12.1)***</td>
<td>9.4 (6.6-13.4)***</td>
<td>5.9 (4.5-7.8)***</td>
<td>6.0 (4.6-8.0)***</td>
<td>6.6 (4.2-10.4)***</td>
<td>6.7 (4.3-10.6)***</td>
</tr>
<tr>
<td>26-30</td>
<td>7.1 (5.0-10.2)***</td>
<td>7.3 (5.1-10.4)***</td>
<td>5.5 (4.2-7.2)***</td>
<td>5.5 (4.2-7.3)***</td>
<td>5.9 (3.8-9.22)***</td>
<td>5.9 (3.8-9.3)***</td>
</tr>
<tr>
<td>31-35</td>
<td>7.0 (4.8-10.0)***</td>
<td>6.8 (4.7-9.8)***</td>
<td>3.7 (2.7-5.0)***</td>
<td>3.7 (2.7-5.0)***</td>
<td>4.9 (3.0-7.9)***</td>
<td>4.8 (3.0-7.8)***</td>
</tr>
<tr>
<td>36-40</td>
<td>4.6 (3.1-6.8)***</td>
<td>4.5 (3.0-6.7)***</td>
<td>3.2 (2.4-4.4)***</td>
<td>3.2 (2.3-4.4)***</td>
<td>3.2 (1.9-5.4)***</td>
<td>3.2 (1.9-5.4)***</td>
</tr>
<tr>
<td>41-45</td>
<td>3.5 (2.3-5.2)***</td>
<td>3.5 (2.3-5.2)***</td>
<td>2.0 (1.4-2.8)***</td>
<td>2.0 (1.4-2.8)***</td>
<td>2.2 (1.28-3.9)***</td>
<td>2.2 (1.3-3.8)***</td>
</tr>
<tr>
<td>46-50</td>
<td>2.0 (1.2-3.1)**</td>
<td>2.0 (1.2-3.1)**</td>
<td>1.5 (1.0-2.2)†</td>
<td>1.5 (1.0-2.2)†</td>
<td>2.0 (1.1-3.5)†</td>
<td>2.0 (1.1-3.5)†</td>
</tr>
<tr>
<td>&gt;50</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Note:** OR: Odds Ratio; CI: Confidence Interval; *p<0.05, **p<0.01, ***p<0.001.
Decleration of Interest

Dr. Werge has served as a lecturer for and consultant to H. Lundbeck A/S. The rest of the authors report no conflict of interest. The authors alone are responsible for the content and writing of the paper.

References


