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Original article

Neuropsychological deficits in adults age 60 and above with attention deficit hyperactivity disorder

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ABSTRACT

Objective: Neuropsychological deficits are of major importance in ADHD, yet no previous studies have assessed clinically referred samples of older adults. The authors compared older adults with ADHD (60–75 years) with both younger adults with ADHD (18–45 years) and older healthy controls with regard to various neuropsychological deficits.
Methods: Well-established tests were used to investigate working memory, inhibition, switching, planning, fluency, and speed of processing. Self-ratings of executive functioning and delay-related behaviors were also included. Both variable-oriented and person-oriented analyses were conducted.
Results: Older adults with ADHD differed from controls with regard to working memory, inhibition, switching, and delay-related behaviors. In comparison to younger adults with ADHD, they performed at a similar level with regard to working memory and planning, but significantly better with regard to inhibition, switching, fluency, speed of processing, and delay aversion. Despite several significant group differences relative to controls, person-oriented analyses demonstrated that a majority of older adults with ADHD performed within the average range on each test and 20% showed no clear deficit within any neuropsychological domain.
Conclusions: The results are in line with models of heterogeneity that have identified different neuropsychological subtypes in ADHD as well as a subgroup of patients without any clear neuropsychological deficits. For older adults with ADHD, it will be important to assess their functioning across time as normal aging is related to memory decline and these patients could therefore end up with severe deficits as they grow older, which in turn could have serious negative effects on daily life functioning.

1. Introduction

Neuropsychological deficits have been shown to be of major importance in attention deficit hyperactivity disorder (ADHD) in both childhood [1] and adulthood [2]. However, no previous studies have addressed this issue in a clinically referred sample of individuals with ADHD above 60 years of age. The overall aim of the present study was therefore to investigate neuropsychological deficits among older adults with ADHD and compare them to both healthy controls in the same age range and younger adults with ADHD. More specifically, the present study focused on deficits in executive functions (i.e., working memory, inhibition, switching, and planning), delay-related behaviors (i.e., the tendency to choose smaller immediate rewards over larger rewards that involve waiting), verbal fluency, and speed of processing. Studying neuropsychological deficits in older adults with ADHD should be considered an important topic, as we know from previous research that ADHD persists into older adulthood with prevalence rates of 2.8–3.3% [3,4]. Older ADHD patients have also been shown to have similar impairments as younger adults with ADHD such as higher rates of comorbid depression, anxiety and perceived somatic health [5], as well as lower educational levels, higher rates of divorce, and more loneliness [6].

With regard to neuropsychological functioning, studies of younger adults have shown that ADHD is associated with deficits in executive functioning such as working memory, inhibition and switching [2,7]. In line with the dual pathway model [8], links have also been found between ADHD and delay-related behaviors [9,10], although results are more inconsistent compared to those found for executive functioning [11]. Only one previous study [12] has

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investigated neuropsychological functioning in older adults with ADHD, and this study used a population-based sample and a lower cut-off for ADHD symptom levels (i.e., 4 symptoms of hyperactivity/impulsivity or inattention) than what is used in the DSM-5 [13]. The result of this study showed a significant group difference only for working memory, which did not remain significant when controlling for comorbid depression. More studies are clearly needed, especially as the sample included few cases in the ADHD group ($n = 23$), more complex executive functions such as switching and planning were not included, and this study did not report measures of diagnostic sensitivity (i.e., the proportion of correctly classified ADHD patients based on the neuropsychological measures) and specificity (i.e. the proportion of correctly classified controls). In studies of younger adults with ADHD, the sensitivity of neuropsychological measures has proven to be relatively poor [11,14] – a fact being interpreted as support for models of heterogeneity that argue that individuals with ADHD vary substantially with regard to their neuropsychological deficits [1,15]. One population-based study using a dimensional measure of ADHD symptoms rather than investigating group differences, showed that associations between symptom severity and neuropsychological functioning were less consistent among older compared to middle-aged adults [16]. This points to the importance of comparing older adults with ADHD not only to healthy controls but also to younger adults with ADHD.

In order to address the limitations of the previous studies described above, the aim of the present study was to investigate a range of different neuropsychological deficits in a clinically referred sample of older adults (60–75 years of age) with ADHD, healthy controls of the same age, and younger adults (age 18–45 years of age) with ADHD. We complemented our study of mean group differences with person-oriented analyses to allow for the identification of neuropsychological subgroups.

2. Method

2.1. Participants and procedure

The study included 158 participants in three groups:

- older adults (60–75 years of age) diagnosed with ADHD ($n = 44$);
- healthy controls of the same age ($n = 58$);
- younger adults (age 18–45 years of age) with ADHD ($n = 56$).

Adults with ADHD were recruited from outpatient psychiatric units in Stockholm specialized in neuropsychiatric disorders and they all met the full diagnostic criteria according to DSM-5 [13] as assessed by trained psychologists/psychiatrists. The diagnostic assessment included a detailed anamnesis, and standardized rating instruments. Information was collected from both the patient him-/herself and a significant other (i.e., a partner, parent, or sibling). As patients were recruited from several different clinics, not all participants were assessed using exactly the same instruments. All patients in the younger ADHD group and 18% of the patients in the older ADHD group were assessed using the second version of the Diagnostic Interview for ADHD in Adults (DIVA 2.0; [17]). This semi-structured clinical interview includes assessment of ADHD symptoms and impairment in five areas of functioning (i.e., education, work, family, social/relationships, and self-confidence) in childhood and at the present time. With regard to standardized rating instruments, childhood ADHD symptom levels were assessed using the Childhood Symptom Scale [18], the Brown Attention Deficit Disorder Rating Scale (Brown ADD-RS; [19]) or the Wender Utah Rating Scale (WURS; [20]). ADHD symptom levels in adulthood were assessed using the 18-item version of the Adult ADHD Self-Report Scale (ASRS; [21]). Comorbid symptoms were assessed using the Mini International Neuropsychiatric Interview (M.I.N.I.; [22]). If comorbid symptoms were identified during this structured interview, it was complemented with one or several standardized rating instruments, depending on the identified symptoms. Finally, current symptom levels were also assessed within the present study using self-ratings on the ASRS [21] and all participants were found to meet the symptom criteria for ADHD according to DSM-5 [13].

Exclusion criteria for both clinical groups were:

- an IQ score $< .70$ on the Wechsler Adult Intelligence Scale (WAIS-IV [23]);
- ongoing substance-related disorders;
- the presence of a serious neurological disorder such as Parkinson's disease, amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), or dementia.

Among the older adults, we also collected information about several aspects that are relatively common among older adults, as they could affect cognitive performance and therefore would need to be taken into consideration in the analyses:

- a score of < 24 on the Mini Mental State Examination (MMSE [24]), which is indicative of cognitive decline; Q3
- ongoing (i.e., during testing) migraine/severe headache, chronic or acute pain, severe physical disabilities, or seriously impaired vision after correction;
- current use of neuroleptic, sedative, anxiolytic, or antiepileptic drugs.

None of the participants (i.e., healthy controls or ADHD patients) who had agreed to participate in the study were found to have problems related to the aspects mentioned above. Among older adults with ADHD, 22 patients were on stimulant medication, but withdrew the medication for at least 24 hours prior to testing. One patient was on non-stimulant medication (i.e., Atomoxetine). In the younger ADHD group, 38 patients were on stimulant medication, and 20 of these patients withdrew the medication for 24 hours. The remaining 18 patients were on medication during testing. However, results were very similar for both the variable- and person-oriented analyses when excluding these patients.

Healthy controls were recruited through local health care clinics and local organizations for senior citizens. Exclusion criteria were the same as described above as well as the presence of any psychiatric disorder. The controls did not differ significantly from the older ADHD group on the MMSE, $t = .88$, *ns*. Participants provided written informed consent after receiving a complete description of the study and the local ethics committee approved the study. All participants received approximately 70 Euros for taking part in the study.

Descriptive statistics are presented in Table 1. The two groups including older adults did not differ with regard to age, $t = 0.53$, *ns*, and the three groups did not differ regarding male–female ratio, $\chi^2 = 0.41$, *ns*, or general intellectual functioning (assessed using the Block Design Subtest from the WAIS-IV [23]), $F = 2.17$, *ns*. However, significant group differences were found for educational level, $F = 55.35$, $P < .001$, with the healthy controls showing the highest educational level and the younger adults with ADHD the lowest.

2.2. Measures of neuropsychological deficits

We used neuropsychological tests from the Delis-Kaplan Executive System (D-KEFS; [25]) and the WAIS-IV [23]. Raw scores were converted into scaled scores (i.e., age-adjusted scores) to allow for comparison between participants of different ages.

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