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Prevalence of Neurocognitive Deficits in Adults with Untreated ADHD: Implications for the Workplace

Brian L. Brooks, Ph.D.
British Columbia Mental Health & Addiction Services

Grant L. Iverson, Ph.D.
University of British Columbia &
British Columbia Mental Health & Addiction Services

Margaret D. Weiss, M.D., Ph.D.
University of British Columbia &
British Columbia Provincial ADHD Program

C. Thomas Gualtieri, M.D., & Lynda G. Johnson, Ph.D.
North Carolina Neuropsychiatry Clinics

Author Notes: The authors wish to thank Ms. Jennifer Bernardo for assistance with handout preparation. Please address correspondence to Brian Brooks, Ph.D., BC Mental Health & Addiction Services, Research Department, Administration Building, 2601 Lougheed Highway, Coquitlam, BC, V3C 4J2. Phone: (604) 524-7390; Fax: (604) 524-7523; Email: blbrooks@bcmhs.bc.ca.

Abstract

A significant proportion of Adults with Attention Deficit Hyperactivity Disorder (ADHD) have neurocognitive difficulties and perform more poorly on neurocognitive tests, including measures of attention and concentration, verbal learning, and executive functioning. These deficits can be subtle, can often go undetected, and can have a direct impact on workplace performance. The purpose of this study is to illustrate the prevalence of neurocognitive deficits in adults with untreated ADHD using a 30-minute computerized neuropsychological battery (CNS Vital Signs). Participants were 105 adults with ADHD as their primary diagnosis. Their average age was 32.3 years (SD=12.9) and their average education was 11.5 years (SD=6.1). The sample was 63.5% male and 85.7% Caucasian. All patients were medication-free at the time of their evaluation, which included computerized neurocognitive testing using CNS Vital Signs (Gualtieri & Johnson, 2006). CNS Vital Signs contains 7 common measures, which provide 15 primary scores, 5 domain scores (e.g., Memory, Psychomotor Speed, Reaction Time, Cognitive Flexibility, and Complex Attention), and a summary score (Neurocognition). Mean performance on the 5 domain scores for the untreated ADHD group were typically 1/3 to 2/3 of a standard deviation (SD) below the mean (Memory=89.7, SD=21.2; Psychomotor Speed=94.5, SD=18.8; Reaction Time=90.4, SD=25.6; Cognitive Flexibility=92.3, SD=25.6; Complex Attention=89.1, SD=27.4). Nearly 63% of this sample had at least one low domain score (i.e., more than 1 SD below the mean). Previous research with healthy control samples has demonstrated that having 2 or more CNS Vital Signs domain scores at or below the 5th percentile likely represents cognitive impairment . When using two or more scores below the 5th percentile as the cutoff for frank neurocognitive impairment, 28.6% of the adults with ADHD scored in this range. A significant minority of adults with untreated ADHD have frank neurocognitive impairment on this rapid computerized battery. These deficits can have a negative impact on workplace functioning, especially when ADHD has not been properly diagnosed and treated.

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Introduction

It is estimated that approximately 4% of the adult workforce has Attention Deficit Hyperactivity Disorder . ADHD is associated, both directly and indirectly, with an average of 35 days annually of lost work performance . Adults with ADHD in the workforce are less likely to maintain full time employment , have lower ranking occupations , have increased absenteeism , and change jobs more often . The impact on workplace performance has financial implications on companies and the economy. The loss of workforce productivity as a result of ADHD is estimated to cost the United States' economy billions of dollars annually .

A significant proportion of adults with ADHD have neurocognitive difficulties and perform more poorly on neuropsychological tests, including measures of attention and concentration, verbal learning, and executive functioning . These deficits can be subtle, can often go undetected, and can have a direct impact on workplace performance . For example, Biederman et al. found that adults with untreated ADHD performed significantly worse in a simulated work environment compared to their healthy counterparts. Their lower work performance was related to problems with inattention and impulsivity, although the authors suggested that there might also have been cognitive deficits that were impacting work performance.

A better understanding of the cognitive deficits associated with adult ADHD is needed. The purpose of this study is to illustrate a methodology for identifying frank neurocognitive deficits in adults with untreated ADHD using a 30-minute computerized neuropsychological battery.

Methods

Participants

Participants were 105 adults with ADHD as their primary diagnosis. Their average age was 32.3 years (SD=12.9) and their average education was 11.5 years (SD=6.1). The sample was 63.5% male and 85.7% Caucasian. Their categories of occupations included: Professional/Technical (41.5%), Student (41.5%), Managerial/Office (7.3%), Skilled Labour (4.9%), Clerical/Sales (2.4%), Unskilled Labour (1.2%), and Not Working/Retired (1.2%). All patients were medication-free at the time of their evaluation, which included computerized neurocognitive testing using CNS Vital Signs (Gualtieri & Johnson, 2006).

Measure

CNS Vital Signs is comprised of seven common neuropsychological measures, including verbal and visual memory, finger tapping, symbol digit coding, the Stroop test, a shifting attention test, and a continuous performance test. The battery generates 15 primary scores, which are used to calculate 5 domain scores (Memory, Psychomotor Speed, Reaction Time, Cognitive Flexibility, and Complex Attention) and a summary score (Neurocognition Index). The measures have good test-retest reliability (mean interval of 62 days, range = 1 to 282 days), adequate concurrent validity with traditional paper and pencil measures and other computerized tests, and the index scores have been shown to discriminate between various clinical groups .

The five CNS-VS domain scores, initially established through a factor analysis of the raw data , are derived by summing multiple primary raw scores. Domain scores are presented as index

scores, with a mean of 100 and standard deviation of 15. Correct responses from the verbal and visual memory tests are summed to generate a composite *Memory Domain* score. The total of right and left taps from the Finger Tapping Test and the total correct responses on the Symbol-Digit Coding Test generate a composite score for *Psychomotor Speed*. Averaging the two complex reaction time scores from the Stroop Test generates a domain score for *Reaction Time*. However, it would be more precise to refer to this domain score as "information processing speed in a test of executive function." The number of correct responses on the Shifting Attention Test, minus the number of errors on the Shifting Attention Test and the Stroop Test, is used to create a domain score for *Cognitive Flexibility*. A domain score for *Complex Attention* is generated by adding the number of errors committed in the Continuous Performance Test, the Shifting Attention Test, and the Stroop Test. The overall summary score, called the *Neurocognition Index*, is derived from the average of the five domain scores.

Analyses

Analysis of the CNS Vital Signs test results involved examining the base rates of low domain scores across the three groups (i.e., neuropsychological profile analysis), followed by chi-square analyses.

Calculations for the base rates of low scores involve simultaneously examining the five domain scores, rather than performance on each domain in isolation. The base rates of low domain scores were calculated by using four cutoff scores that might be routinely used in clinical practice, including: (a) more than 1 standard deviation (SD) below the mean (i.e., < 85), (b) below the 10th percentile (i.e., < 81), (c) at or below the 5th percentile (i.e., ≤ 76), and (d) more than 2 SDs below the mean (i.e., < 70).

Results

Mean performance on the 5 domain scores for the untreated ADHD group were typically 1/3 to 2/3 of a standard deviation (SD) below the mean (Memory = 89.7, SD = 21.2; Psychomotor Speed = 94.5, SD = 18.8; Reaction Time = 90.4, SD = 25.6; Cognitive Flexibility = 92.3, SD = 25.6; Complex Attention = 89.1, SD = 27.4).

The base rates of low scores are presented in Table 1. Nearly 63% of this sample had at least one low domain score (i.e., more than 1 SD below the mean). Previous research with healthy control samples has demonstrated that having 2 or more CNS Vital Signs domain scores at or below the 5th percentile likely represents cognitive impairment . When using two or more scores below the 5th percentile as the cutoff for frank neurocognitive impairment, 28.6% of the adults with ADHD scored in this range.

Table 1. Base rates of low CNS Vital Signs domain scores in adults with ADHD.

Number of Low Scores	< 1 SD		< 10th %ile		≤ 5th %ile		< 2 SDs		Number of Low Scores
	%	C%	%	C%	%	C%	%	C%	
5	7.6	7.6	6.7	6.7	4.8	4.8	1.0	1.0	**5**
4	8.6	16.2	3.8	10.5	3.8	8.6	4.8	5.8	**4**
3	13.3	29.5	13.3	23.8	7.6	16.2	8.6	14.4	**3**
2	9.5	39.0	12.4	36.2	12.4	28.6	7.6	22.0	**2**
1	23.8	62.8	21.9	58.1	27.6	56.2	19.0	41.0	**1**

0	37.1	100	41.9	100	43.8	100	59.0	100	**0**

Note: There are slight variations due to rounding. Base rates are based on the simultaneous analysis of the 5 domain scores, including Memory, Psychomotor Speed, Reaction Time, Cognitive Flexibility, and Complex Attention.

Conclusions

Our goal was to highlight the prevalence of cognitive deficits in adults with untreated ADHD in the context of the potential impact on workplace performance. Problems with memory, psychomotor speed, reaction time, complex attention, and cognitive flexibility were relatively common in this sample. In our study, a significant minority of adults with untreated ADHD were found to have frank neurocognitive impairment on this computerized battery. Using our previously established guideline of 2 or more scores at or below the 5th percentile, 28.6% of adults with untreated ADHD were identified as having frank impairment.

The cognitive deficits identified in adults with ADHD using the computerized battery can have a negative impact on workplace functioning. It is possible that those workers with cognitive impairment are more likely to have problems performing their expected job duties and are more likely to result in lost productivity in the workforce. Several authors have recommended treatment for adults with ADHD, both in the form of medication and behavioral management, in order to improve workplace functioning . The subgroup of adults with the most compromised cognitive functioning can be easily identified (i.e., using a rapid computerized battery), treated, and their cognition can be monitored serially to determine if it improves with treatment.