

# Functional impairment in adults positively screened for attention-deficit hyperactivity disorder: The role of symptom presentation and executive functioning

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## Abstract

**Background:** While the number of symptoms of attention-deficit hyperactivity disorder (ADHD) decreases with age, a high proportion of adults with ADHD symptoms suffer from persistent functional impairment (Fi) linked to these symptoms. Our objective was to investigate the specific roles of two potentially important predictors of this Fi: the clinical symptom presentation and the deficit in executive functions (EFs).

**Methods:** A total of 158 subjects from a community sample positively screened for ADHD were classified into two groups: those with and without Fi. Following a detailed diagnostic process, participants were administered a self-rating scale for ADHD symptoms as well as a neuropsychological test battery containing tests of EF and attention relevant as potential cognitive endophenotypes for ADHD.

**Results:** The overall number as well as the number of inattentive, hyperactive and impulsive symptoms, confirmed both by examiner and self-report, were significantly higher among Fi subjects. The highest odds ratio for Fi was associated with impulsive symptoms. Additionally, self-reported complaints of problems with self-concept were significantly higher among Fi subjects. No significant relationship between Fi and neuropsychological measures of EF and attention was detected.

**Conclusions:** This study revealed that the number of symptoms, in particular that of impulsivity, had a significant impact on Fi in adults with symptoms of ADHD. Furthermore, our results underline the importance of assessing complaints and behaviors related to self-concept, which are not included in *DSM-IV* diagnostic criteria of ADHD but nonetheless may be associated with functional outcome of the disorder.

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## 1. Introduction

Attention-deficit hyperactivity disorder (ADHD) is a genetically based neurodevelopmental condition [1] with childhood onset that manifests in symptoms of inattention, hyperactivity and impulsivity, and leads to clinically significant functional impairment (Fi) linked to these symptoms [2]. As follow-up studies have confirmed, ADHD often persists into adulthood [3], with similar

neuropsychological, electrophysiological and neuroimaging correlates with those reported in children. Nonetheless, adult ADHD differs in clinical features: the number of overt symptoms decreases with increasing age [4,5], despite the fact that the disorder has a detrimental impact on academic, occupational and social functioning [6]. Hence, subjects with childhood ADHD often do not fulfill the full diagnostic criteria of ADHD in adulthood, providing a diagnostic challenge, as they continue to suffer from clinically significant Fi.

The relationship between ADHD symptoms in the adult population and the persisting Fi linked to these symptoms as well as the issue of the potential predictors of impairment have gained relatively little attention in the literature. In young adults (age range: 19–25 years) diagnosed with ADHD in childhood, Barkley found only a modest correlation (mean  $r = 0.25$ ) between the number of symptoms and certain measures of functional outcome (cited in

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Gordon et al. [7]). Correlations of symptom domains with impairment were higher (range = 0.45–0.53) when an overall index of impairment was examined. Nonetheless, only a modest amount of variance in Fi (20%–28%) was accounted for by this relationship. Additionally, in another study of adult ADHD (age range: 32–38 years) Barkley et al. [8] found high correlations (range: 0.67–0.84) between symptom domains and both the number of impaired functional domains and the rating on the Social and Occupational Functioning Assessment Scale. Mannuzza et al. [9] in a 33-year follow-up study, also reported high correlations of 0.83–0.85 between the number of symptoms and the degree of impairment in middle-aged men diagnosed with ADHD in their childhood. Furthermore, that study found that clinical impairment was evidenced by all participants with five or more ADHD symptoms of inattention or hyperactivity/impulsivity. Additionally, in a population-based sample of middle-aged adults (range: 47–54 years), Das et al. [10] found significant associations between ADHD “symptom traits,” based on the screener version of the Adult ADHD Self-report Scale (ASRS), and measures of employment, financial stress, relationship quality, health and well-being. In particular, similar to other studies [11,12], the inattention trait showed a strong association and remained significant even after controlling for comorbid depression and anxiety symptoms. In sum, the overall number of ADHD symptoms, in particular that of inattention, seems to correlate at a moderate to high level with the persistence of Fi in adults, but does not fully explain it.

Intact functionality is associated with good executive functioning, which is often defined as the ability of the cross-temporal organization of behavior [13], or the maintenance of problem-solving sets [14] to achieve future goals. While in recent years the role of the executive function (EF) deficits in Fi has been well established in major mental illness including schizophrenia [15–17], the contribution of EF deficits to Fi in ADHD is still an open question. Although current theories of the disorder emphasize its neuropsychological heterogeneity [18], several reviews and meta-analyses have confirmed that executive dysfunctions are present in both children [19] and adults with ADHD [20–22]. Besides the possibility of an overall impairment, recent genetic association studies, in addition to reaction time variability [23], suggested that certain specific EFs (such as response inhibition, working memory and set shifting, along with processing speed) share their genetic basis with ADHD, and thus are thought to be potentially useful cognitive endophenotypes for ADHD [23–27].

In addition, while the general role of neuropsychological tests in the diagnosis of ADHD is in question [28], executive deficits of ADHD patients measured by them are relatively stable from childhood on into young adulthood. These deficits appear to be independent of the remission of symptoms of inattention or hyperactivity/impulsivity [29]. Thus, a possible relationship between executive functioning

of adults with ADHD and Fi persisting into adulthood is conceivable.

Based on the above data, we aimed to investigate two questions in our study. First, in adults with symptoms of ADHD, we investigated whether the presence of clinically significant Fi correlates with the degree of presentation of psychopathological symptoms, as indexed by the overall number of symptoms, especially those of inattention. Second, we also investigated whether a relationship between Fi and EF deficits exists in ADHD. For the purpose of this investigation, we focused on subjects from a community sample positively screened for ADHD.

## 2. Methods

This investigation was part of a larger study examining the epidemiology, neuropsychology, genetic background, psychopathology and clinical features of adult ADHD in Hungary. As this paper reports on the psychopathological and neuropsychological data related to Fi, here we present only the brief description of the study design and data collection. For further details we refer to Bitter et al. [30].

### 2.1. Participants and procedure

From June 2006 to June 2007, 3529 patients of 17 GP practices in the area of Budapest, Hungary were screened for ADHD with the screener version of the ASRS. All subjects included in the study were between 18 and 60 years of age from both genders without any major neurological disorder in their clinical history. Of the 279 positively screened subjects 82 refused participation, 39 failed to show up for the further investigation, and 158 (42 males and 116 females with a mean age (SD) of 41.54 (11.6) years) entered the second phase of the study. Unlike clinical investigations which rely on clinically referred samples, and comprise predominantly male subjects, due to the screening approach, as a unique feature of our epidemiological study, a little over two-thirds (73%) of our sample was female.

The 158 subjects who entered the second phase of the study participated in a clinical interview conducted by trained interviewers; filled in the Conners Adult ADHD Rating Scale–Self-report (CAARS-S) in order to confirm the diagnosis of adult ADHD; and underwent a detailed neuropsychological assessment. The clinical interview had two parts: a structured diagnostic interview developed by the study group using symptom list and further diagnostic criteria of ADHD in *DSM-IV*; and a free clinical interview in order to collect relevant background information for supporting the validity of the clinical diagnosis.

To investigate our first question, first we defined an overall criterion for functional impairment by combining the ADHD diagnostic criteria C and D (impairment in at least two domains of functioning along with clinically significant impairment in at least one domain of functioning linked to ADHD symptoms) (i.e., required the fulfillment of both

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