**Original Article**

# Visuo-spatial Attention in ADHD Children: Investigating the Asymmetry

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**Objectives:** The purpose of the present study was comparing visuo-spatial attention between children with Attention Deficit Hyperactivity Disorder-Inattentive (ADHD-I) type and normal children.

**Method and Material:** In this cross-sectional study fifteen (7-10 years of age) children were classified with ADHD-I type and 15 normal children were matched for age, sex, and IQ. They were selected trough simple random sampling. Measurement tools were Wechsler Intelligence Scale for children 4th edition (WISC-IV), the Edinburgh Handedness Inventory and the Star Cancellation Test.

**Results:** The results suggest that there is no significant difference between ADHD-I and normal children from the visuo-spatial standpoint (p>0/05). But three ADHD-I children exhibited signs of unilateral neglect.

**Discussion:** Although, in this study the visuo-spatial attention was not different between ADHD-I group and normal group, considering this form of attention as an item in assessment and therapeutic interventions should not be neglected.

**Key words:** Attention Deficit Hyperactivity Disorder, Visuo-spatial attention, Unilateral neglect

## Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common psychiatric disorders of childhood. Typically children with ADHD have developmentally inappropriate behavior, including poor attention skills, impulsivity and hyperactivity. ADHD is estimated to affect about 3-5% of the school-age population. Even though the exact cause of ADHD remains unknown, it is known that ADHD is a neurobiologically based disorder. According to the Diagnostic and Statistical Manual for Mental Disorders (4th edition, text revised: DSM-IV-TR) ADHD consists of three subtypes: ADHD-combined type, ADHD-Hyperactive-Impulsive type and ADHD-predominantly Inattentive type (1). ADHD-I type has problems in sustained and selective attention, working memory and speed of processing (2). Anatomically various neural networks and regions are affected such as prefrontal cortex which has an incredible role in ADHD deficits like deficit in selective attention, divided attention, working memory, planning, *etc.* (3). There are some studies that indicate the decrease of fronto-striatal networks and parietal lobe's activation. The deficit has been shown in right cortical regions (prefrontal, parietal) and subcortical regions (straiatal, thalamic) as well. The clinical features of these deficits are shown through pathological bias in visuo-spatial attention (4).

Visuo-spatial attention is orienting to locations in visual space (5). Normal adults typically show a leftward bias which is attributed to right hemisphere dominance for visuo-spatial tasks (6). Right hemisphere lesions reduce intentional capacity that may manifest as neglect syndrome. This syndrome is a condition in which there is unawareness of, and failure to respond to stimuli on one side of the body (7). Due to deficits in attention in ADHD children, perceptual problems like attentional asymmetries have seen. There are several studies in this field that have exhibited a relation between ADHD and reduction of awareness for visual stimulations in left side of the space (8, 9, 10, 11). In contrast some studies found no significant relation between these

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two items (11, 12). Visuo-spatial attention is a necessary component in learning. The high comorbidity rate of learning disabilities with ADHD might be the cause of the spatial attention deficits; thus it was decided this study to be performed.

**Method and Material**

In this cross-sectional study 15 (7-10 years of age) children were classified with ADHD-I type and 15 normal children were matched for age, sex and IQ. Samples were selected through simple random sampling. Participants were administered the Wechsler Intelligence Scale for children 4th edition (WISC-IV). They had to gain a score 90-120. The Edinburgh Handedness Inventory (EHI) was used to confirm that all participants were right-handed. Participants who met the inclusion criteria, invited to do the Star Cancellation Test in another day. With the permission of the physician, the parents were asked not to give methylphenidate medication on the visuo-spatial test day (star cancellation). The Star Cancellation Test consists of a white 29.0cm×20.3cm sheet showing 56 black small star targets together with 72 black distracters in a quasi-random distribution. The examiner places the sheet in front of and at the midline of the participant and asks him/her to find and cross out all of the small stars on the page. Two stars in the center of the page are crossed out by the examiner to illustrate the procedure (13). The maximum score that can be achieved on the test is 56 points. A laterality Index or Star Ratio can be calculated from the ratio of stars cancelled on the left side of the page to the total number of stars cancelled. Scores between 0.56 and 1 indicate unilateral neglect in the right hemispace and scores between 0 and 0.46 indicate unilateral neglect in the left hemispace.

**Results**

Fifteen ADHD-I children completed this measure marked a mean of 26.00/27 targets on the left (SD=1.25) and 24.87/27 targets on the right (SD=2.16). The control group marked a mean of 26.87/27 targets on the left (SD=0.51) and 27/27 targets on the right side (SD=0). The Mann-Withney U test was used to compare Star Ratio between the two groups. There was no difference between ADHD-I and control group ($p>0.05$) but 3 cases showed unilateral neglect. Table 1 indicates the results of the Star Ratio, two children (number 1, 5) showed unilateral neglect in right side and one child (number 13) showed unilateral neglect in left side.

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0/500 | 0/509 | 0/469* | 0/490 | 0/500 | 0/490 | 0/500 | 0/509 | 0/519 | 0/509 | 0/541* | 0/531 | 0/521 | 0/531 | 0/541* | ADHD-I |

**Discussion**

We have found no significant difference in visuo-spatial attention between ADHD-I group and normal group, but there were 3 cases who exhibited unilateral neglect. George M. and colleagues in a case study indicated the rightward bias in the Star Cancellation Test for a child with ADHD (14). The result of our study in contrast to George's study indicates a leftward bias in ADHD-I group. This contrast might be due to not considering ADHD subtypes classification in George's study (14). There are some studies showed a rightward bias in ADHD-Combined type (15, 12). Rolf and colleagues used two types of Line Bisection tests, which are visuo-spatial test. They found that in paper and pencil type of the Line Bisection test, ADHD-I showed a leftward bias (15). It supports our findings in present study. But in computerized type of the Line Bisection test, ADHD-I group showed a rightward bias which is not matched with result of present study. To be conclude ADHD-I group should be checked and assessed through perceptual asymmetries. Based on our findings some of ADHD-I children might have unilateral neglect signs and these kind of signs definitely have a major effect on their academic and educational skills.

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