

## مقایسه بازداری پاسخ و کنترل تداخل در کودکان مبتلا به اختلال نارسایی توجه/فزون کنشی و کودکان بهنجار

### The Comparison of Response Inhibition and Interference Control in ADHD and Normal Children

/ / :

// :

Mashhadi, A.\*Ph.D., Rasoulzadeh-Tabatabaie, K. Ph.D., Azadfallah, P. Ph.D., Soltanifar, A. M.D.

\*\* \*  
\*\*\* \*\*

#### Abstract

**Introduction:** Response inhibition and interference control are two main explanatory concepts in ADHD. The purpose of this study was comparing the response inhibition and interference control in children with and without ADHD and its subtypes.

**Method:** 45 children with ADHD and 15 normal children aged 7 to 12 years were selected none randomly from Mashhad. SNAP, CBCL, RF, CSI-4 and clinical interview for diagnosing ADHD and put them into ADHD-I, ADHD-H, ADHD-C subtypes was applied. The color-word Stroop test was performed for assessing the inhibition and interference control. The data was analyzed by MANOVA, ANOVA and Tukey statistical tests.

**Results:** The results indicate that in comparison with normal children the performance of ADHD children in reaction time component was significantly different both in congruent and incongruent stimuli. Furthermore the findings on the interference control indicate non significant difference between two groups. Also, there was a non significant difference between subtypes of ADHD on Stroop test components.

**Conclusion:** In comparison to normal children, the performance in Stroop test was weaker in ADHD children.

**Keywords:** Attention Deficit/Hyperactivity Disorder (ADHD), executive Functions, Response Inhibition, Interference Control.

ADHD  
ADHD  
CSI-4 TRF CBCL SNAP  
(MANOVA)  
(ANOVA)  
ADHD  
ADHD

\*Correspondence E-mail:  
mashhadia@yahoo.com

(ADHD) /

. [ ]

ADHD [ ]

]

. [

( ) /

. [ ]

. [ ]

DSM IV TR

:

(ADHD-I)

( )

(ADHD-H) /

( )

. (ADHD-C)

:

-

. [ ]

( )

. [ ]

ADHD

<sup>1</sup> - Attention Deficit Hyperactivity

<sup>2</sup> - Diagnostic and Statistical Manual of Mental Disorders (DSM)

<sup>3</sup> - Inattention

<sup>4</sup> - Impulsiveness

<sup>5</sup> - Hyperactivity

<sup>6</sup> - Disinhibition

<sup>7</sup> - ADHD predominantly inattentive subtype (ADHD-I)

<sup>8</sup> - ADHD predominantly hyperactive/impulsive subtype (ADHD-H)

<sup>9</sup> - ADHD combined subtype (ADHD-C)

<sup>10</sup> - Prefrontal Lobe

<sup>11</sup> - Executive Disfunction

<sup>12</sup> - Inhibition

<sup>13</sup> - Working Memory

<sup>14</sup> - Planning

. [ ]

. [ ]  
ADHD

:

( )

. [ ]

( )

)

. [ ]( [ ]

ADHD ADHD

. [ ]

. [ ]

. [ ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

---

<sup>15</sup> - Continues performance test  
<sup>16</sup> - Sign –Stop test  
<sup>17</sup> - Stroop test

( )  
 .[ ] )  
 ( )  
 .[ ]

ADHD ]

.[ ADHD

) ( )  
 ( )  
 .[ ] .[ ]

.[ ] / /

/ .[ ] .[ ] ( / )

.[ ]

ADHD  
 [ ] .[ ]

[ ] .[ ]

[ ]

---

<sup>18</sup> - Congruent  
<sup>19</sup> - Incongruent  
<sup>20</sup> - Reaction Time



/ / .[ ] ) ( )  
 CSI- ) (4  
 ASEBA  
 .[ ]  
 :(CSI-4)  
 -  
 .[ ]  
 CSI-4 . DSM-IV  
 .[ ]  
 = = = =  
 = = = =  
 :  
 = ) .[ ]  
 - / /  
 (

<sup>24</sup> - Child Symptom Inventory-4

[ ]

[ ]

/ /

[ ]

:

/

)

.(

)

(

)

SNAP-IV

(

(CBCL)

(TRF)

( ) (CSI-4)

(

)

(MANOVA)

(ANOVA)

<sup>25</sup>- Tukey test

) ADHD

( ) (

(p > / )

(F( ) = / p > / )

ADHD

( )

( )

/

(MANOVA)

F( ) = / p < / )

(RT)

(

θ = /

(RT)

(ANOVA)

/

p < / )

ADHD

(F( ) = /

(F( ) = / p < / )

(F( ) = / p < / )

(F( ) = p < / )

p < / )

(F( ) = /

( )										
/	/									
/	/	/	/			/				
/	/	/	/	/	/		/	/	/	
/	/		/		/					
/	/	/	/	/	/	/	/	/	( )	

		<b>ADHD</b>							
		<b>ADHD(C)</b>		<b>ADHD(HI)</b>		<b>ADHD(I)</b>			
<b>SD</b>	<b>M</b>	<b>SD</b>	<b>M</b>	<b>SD</b>	<b>M</b>	<b>SD</b>	<b>M</b>		
/	/	/	/	/	/	/	/	( )	
/	/	/	/	/	/	/	/		
/	/	/	/	/	/	/	/		
/	/	/	/	/	/	/	/		
/	/	/	/	/	/	/	/		
/	/	/	/	/	/	/	/		
/	/	/	/	/	/	/	/		
/	/	/	/	/	/	/	/	<b>RT</b>	
/	/	/	/	/	/	/	/	( )	
/	/	/	/	/	/	/	/		

	<b>F</b>						
/	/	/		/		( )	
/	/	/		/			
/	/	/		/			
/	/	/		/			
/	/	/		/			
/	/	/		/			
/	/	/		/			
/	/	/		/		<b>RT</b>	
/	/	/		/		( )	
/	/	/		/			

ADHD

ADHD

[ ]

[ ]

ADHD

[ ]

ADHD

[ ]

[ ]

[ ]

ADHD

( )

MR. Hyperactivity in Boys with Attention-Deficit/Hyperactivity Disorder (ADHD): A Ubiquitous Core Symptom or Manifestation of Working Memory Deficits. *Journal of Abnormal Child Psychology*. 2009; (37):521–534.

10. Nigg JT. What causes ADHD?: Understanding What Goes Wrong and Why. New York :The Guilford Press; 2006.

11. Krain AL, Castellanos FX. Brain development and ADHD. *Clinical Psychology Review*. 2006; (26):433–444.

12. Castellanos FX, Tannock R. Neuroscience of attention-deficit/hyperactivity disorder: the search for endophenotypes. *Nature Review Neuroscience*. 2002; (3): 617–628.

13. Lezak MD, Howieson DB, Loring DW. *Neuropsychological Assessment* 4th ed. New York: Oxford University Press; 2004.

14. Welsh MC, Pennington BY. Assessing frontal lobe functioning in children: View from developmental psychology. *Developmental Neuropsychology* 1988; (4): 199-230.

15. Denckla MB. Executive function: Building together the definitions of attention deficit/hyperactivity disorder and learning disabilities. In L. Meltzer (Ed.), *Executive function in education*. New York: Guilford Press; 2007. pp. 5–18.

16. Gioia GA, Isquith PK. New perspectives on educating children with ADHD: contributions of the executive functions. *Journal of Health Care Law and Policy*. 2002; (5): 124-163.

17. Pennington BF, Ozonoff S. Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry*. 1996; (37): 51-87.

18. Rapport MD, Alderson MR, Kofler MJ, Sarver, DE, Bolden, J, Sims V. Working Memory Deficits in Boys with Attention-deficit/ Hyperactivity Disorder (ADHD): The Contribution of Central Executive and Subsystem Processes. *Journal of Abnormal Child Psychology* .2008; (36):825–837.

19. Rapport M D, Bolden J, Kofler M J, Sarver, DE, Raiker JS. Alderson MR Hyperactivity in Boys with Attention-Deficit/Hyperactivity Disorder (ADHD): A Ubiquitous Core Symptom or Manifestation of Working Memory Deficits? *Journal of Abnormal Child Psychology*. 2009; (37): 521–534.

[ ]

1. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: author; 2000.

2. Barkley RA. *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment*. (3rd ed). New York: Guilford Press; 2006.

3. Sadock BJ, Sadock VA, Kaplan H. *Synopsis of Psychiatry: Behavioral Sciences/Clinical Psychiatry*. (10<sup>th</sup> ed). New York: Lippincott Williams & Wilkins; 2007.

4. Barkley RA. Behavioral inhibition sustained attention and executive functions Constructing a unifying theory of ADHD. *Psychological Bulletin*. 1997; (121): 65–94.

5. Barkley RA. Genetics of childhood disorders: XVII. ADHD, Part 1: The executive functions and ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2000; (39):1064–1068.

6. Barkley RA. *ADHD and the nature of self-control*. New York: Guilford Press; 2005.

7. Brown TE. *Attention deficit disorder : the unfocused mind in children and adults*. New Haven: Yale University Press; 2005.

8. Brown TE. Executive functions in attention deficit hyperactivity disorder: Implications of two conflicting views. *International Journal of Disability Development and Education*. 2006; (53): 35-46.

9. Rapport M D, Bolden J, Kofler MJ, Sarver, DE, Raiker JS, & Alderson,

- deficit/hyperactivity disorder and their unaffected siblings. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2004; (43): 332–340.
32. Baron S. *Neuropsychological evaluation of the child*. New York: Oxford University press; 2004.
33. Stroop J. Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*. 1935; (18): 643–662.
34. MacLeod CM. Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*. 1991; (109): 163–203.
35. MacLeod D, Prior M. Attention deficits in adolescents with ADHD and other clinical groups. *Child Neuropsychology*. 1996; (2): 1–10.
36. Spreen O, Strauss E. *Compendium of Neuropsychological Tests, Administration, Norms, and Commentary (2 Ed)*. New York: Oxford University press; 1998.
37. Homack S, Riccio CA. A meta-analysis of the sensitivity and specificity of the Stroop color and word test with children. *Archives of Clinical Neuropsychology*. 2004; (19): 725–743.
38. Grodzinsky GM, Diamond R. Frontal lobe functioning in boys with attention-deficit hyperactivity disorder. *Developmental Neuropsychology*. 1992; (8): 427–445.
39. Golden ZL, Golden CJ. Patterns of performance on the Stroop color and word test in children with learning, attentional, and psychiatric disabilities. *Psychology in the Schools*. 2002; (39): 489–495.
40. Shallice T, Marzocchi GM, Coser S, Del Savio, M, Meuter, RF, Rumiati, R I. Executive function profile of children with attention deficit hyperactivity disorder. *Developmental Neuropsychology*. 2002; (21): 43–71.
41. Scheres A, Oosterlaan J, Geurts H, Morein-Zamir S, Meiran N, Schut H, Vlasveld L, Sergeant JA. Executive functioning in boys with ADHD: Primarily and inhibition deficit? *Archives of Clinical Neuropsychology*. 2004; (19): 569–594.
42. Schmitz M, Cadore L. et al. Neuropsychological performance in DSM-IV ADHD subtypes: an explanatory study with untreated adolescents. *Canadian Journal of Psychiatry*. 2002; (47): 863–869.
43. Seidman LJ, Biederman J, Faraone SV, Weber W, Mennin D, Jones J. A pilot study of neuropsychological function in girls with ADHD. *Journal of the American*
20. MacLeod C, Gorfein D, *Inhibition in cognition*. Washington, DC: American Psychological Association; 2007.
21. Schachar R, Logan G. Impulsivity and inhibitory control in normal development and childhood psychopathology. *Developmental Psychology*. 1990; (26): 710–720.
22. Schachar R, Nita, VL, Logan, GD, Tannock, R, Klim, P. Confirmation of an inhibitory deficit in attention-deficit/hyperactivity disorder. *Journal of Abnormal Child Psychology*. 2000; (28): 227–235.
23. Schachar R, Tannock R, Logan G. Inhibitory control, impulsiveness, and attention deficit hyperactivity disorder. *Clinical Psychology Review*. 1993; (13): 721–739.
24. Schachar R, Tannock R, Marriott M, Logan GD. Deficient inhibitory control and attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology*. 1995; (23): 411–437.
25. Verbruggen F, Logan GD. Proactive Adjustments of Response Strategies in the Stop-Signal Paradigm. *Journal of Experimental Psychology: Human Perception and Performance*. 2009; (35): 835–854.
26. Miyake A, Friedman NP, Emerson MJ, Witzki AH, Howerter A, Wager TD. The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*. 2000; (41): 49–100.
27. Nigg JT. On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin*. 2000; (126): 200–246.
28. Nigg JT. Is ADHD an inhibitory disorder? *Psychological Bulletin*. 2001; (127): 571–598.
29. Mullane JC, Corkum PV, Klein RM, McLaughlin E. Interference Control in Children with and without ADHD: A Systematic Review of Flanker and Simon Task Performance. *Child Neuropsychology*. 2009; (15): 321–342.
30. Achenbach TM, Rescorla LA. *Multicultural Understanding of Child and Adolescent Psychopathology: Implications for Mental Health Assessment*. New York: Guilford Press; 2007.
31. Durston S, Hulshoff Pol HE, Schnack HG, Buitelaar JK, Steenhuis MP, Minderaa, RB. et al. Magnetic resonance imaging of boys with attention-

- executive function theory of Attention-Deficit/Hyperactivity Disorder: A meta-analytic review. *Biological Psychiatry*. 2005; (57): 1336–1346.
54. Milich R, Ballentine AC, Lynam DR. ADHD/combined type and ADHD/predominantly inattentive type are distinct and unrelated disorders. *Clinical Psychology: Science and Practice*. 2001; (8): 463–488.
55. Diamond A. Attention-deficit disorder (attention-deficit/hyperactivity disorder without hyperactivity): A neurobiologically and behaviorally distinct disorder from attention-deficit/hyperactivity disorder (with hyperactivity). *Development & Psychopathology*. 2005; (17): 807–825.
56. Geurts HM, Verté S, Oosterlaan J, Roeyers H, Sergeant JA. ADHD subtype: do they differ in their executive functioning profile? *Archives of Clinical Neuropsychology*. 2005; (20): 457–477.
57. Klorman R, Hazel-Fernandez LA, Shaywitz SE, Fletcher JM, Marchione KE, Holahan JM, et al. Executive functioning deficits in attention-deficit/hyperactivity disorder are independent of oppositional defiant or reading disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1999; (38): 1148–1155.
58. Lockwood KA, Marcotte AC, Stern C. Differentiation of attention-deficit/hyperactivity disorder subtypes: Application of a neuropsychological model of attention. *Journal of Clinical and Experimental Neuropsychology*. 2001; (23): 317–330.
59. Gomez R. Underlying processes in the poor response inhibition of children with attention deficit/hyperactivity disorder. *Journal of Attention Disorders*. 2003; (6): 111–122.
60. Berlin L, Bohlin G, Nyberg L, Janols L. How well do measures of inhibition and other executive functions discriminate between children with ADHD and controls? *Child Neuropsychology*. 2004; (10): 1–13.
61. Schweiger A, Abramovitch A, Doniger G, Simon E. A clinical construct validity study of a novel computerized battery for the diagnosis of ADHD in 134 young adults. *Journal of Clinical and Experimental Neuropsychology*. 2007; (29): 100–111.
- Academy of Child and Adolescent Psychiatry. 1997; (36): 366–373.
44. Seidman LJ, Biederman J, Monuteaux MC, Doyle AE, Faraone SV. Learning disabilities and executive dysfunction in boys with attention deficit/hyperactivity disorder. *Neuropsychology*. 2001; (15): 544–556.
45. Sergeant JA, Geurts H, Oosterlaan J. How specific is a deficit of executive functioning for attention-deficit/hyperactivity disorder? *Behavioural Brain Research*. 2002; (130): 3–28.
46. Semrud-Clikeman M, Steingard RJ, Filipek P, Biederman J, Bekken K, Renshaw PF. Using MRI to examine brain-behavior relationships in males with attention deficit disorder with hyperactivity. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2000; (39): 477–484.
47. Van Mourik R, Oosterlaan J, Sergeant J. The Stroop revisited: A meta-analysis of interference control in AD/HD. *Journal of Child Psychology and Psychiatry*. 2005; (46): 150–165.
48. Houghton S, Douglas G, West J, Whiting K, Wall M, Lansford S, Powell L, Carroll A. Differential patterns of executive function in children with attention-deficit hyperactivity disorder according to gender and subtype. *Journal of Child Neurology*. 1999; (14): 801–805.
49. Nigg JT, Blaskey L, Huang-Pollack C, Rappley MD. Neuropsychological executive functions and ADHD DSM-IV subtypes. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2002; (41): 59–66.
50. Nigg JT, Willcutt E, Doyle A, Sonuga-Barke E. Causal heterogeneity in attention-deficit/hyperactivity disorder: Do we need neuropsychological impaired subtypes? *Biological Psychiatry*. 2005; (57): 1224–1230.
51. Lansbergen MM, Kenemans JL, Engeland HV. Stroop Interference and Attention-Deficit/Hyperactivity Disorder: A Review and Meta-Analysis. *neuropsychology*. 2007; (21): 251–262.
52. Frazier TW, Demaree HA, Youngstrom EA. Meta-analysis of intellectual and neuropsychological test performance in attention-deficit/hyperactivity disorder. *Neuropsychology*. 2004; (18): 543–555.
53. Willcutt EG, Doyle AE, Nigg JT, Faraone SV, Pennington BF. Validity of the

71. Gadow KD, Sprafkin J. The symptom inventories: An annotated bibliography [On-line]. Available: www.checkmateplus.com. 2007.

.۷۲

:( )

62. Chhabildas N, Pennington BF, Willcutt EG. A comparison of the neuropsychological profiles of the DSM-IV subtypes. *Journal of Abnormal Child Psychology*. 2001; (29): 52–540.

63. Faraone SV, Biederman J, Weber W, Russell RL. Psychiatric, neuropsychological, and psychosocial features of DSM-IV subtypes of attention deficit/hyperactivity disorder. *Journal of the American Academy for Child and Adolescent Psychiatry*. 1998; (37): 185–193.

64. Hartung CM, Milich R, Lynam DR, Martin CA. Understanding the relations among gender, disinhibition, and disruptive behavior in adolescents. *Journal of Abnormal Psychology*. 2002; (111): 659–664.

65. Murphy KR, Barkley RA, Bush T. Young adults with attention deficit hyperactivity disorder: Subtype differences in comorbidity, educational, and clinical history. *The Journal of Nervous and Mental Disease*. 2001; (190):147–157.

66. Swanson J, Schuck S, Mann M, Carlson C, Hartman K, Sergeant J. et al .Categorical and dimensional definitions and evaluations of symptoms of ADHD: The SNAP and the SWAN Ratings Scales [Draft]. Available at: [http://www.adhd.net/SNAP\\_SWAN.pdf](http://www.adhd.net/SNAP_SWAN.pdf) 2005.

67. Bussing R, Fernandez M, Harwood M, Hou H, Garvan CW, Eyberg SM, Swanson JM, Parent and Teacher SNAP-IV Ratings of Attention Deficit Hyperactivity Disorder Symptoms: Psychometric Properties and Normative Ratings From a School District Sample. *Assessment*. 2008; (15): 317-328.

.۶۸

SNAP-IV

: ( )

.۶۹

.(ASEBA)

: ( )

.۷۰

(CSI-4)