

Comparative analysis of brain executive functions in girls and boys and determination the relationship of executive functions with depression disorder

Ziba Shahabi¹ , Abolghasem Mehrinejad² , Monavareh Yazdi³ , Zohreh Khosravi⁴

1. Student of phd ,Alzahra University, Tehran, Iran.
www.ziba.shahabi@yahoo.com
2. associate professore, Alzahra University, Tehran, Iran
3. associate professore, Alzahra University, Tehran, Iran
4. associate professore, Alzahra University, Tehran, Iran

Abstract: The aim of current study is comparative analyzing of executive functions in girls and boys and also determination the relationship of executive functions with depression disorder. Method: the sample includes 1200 students (600 girls, 600 boys) of elementary school who were selected through multi step cluster sampling from all of students of Tehran. Sample group of depression disorder includes 45 students (24 girls and 21 boys) who were selected through a questionnaire. Gathered Data were analyzed by behavioral ranking inventory of executive functions and the questionnaire of morbid symptoms of children through statistical descriptive and inferential methods. Results: in comparison of executive functions of girls and boys by behavioral ranking inventory of executive functions (Brief), girls were better than boys in all of functions except emotional control. The results of analysis of relationship between executive functions with depression disorder showed that there were a negative relationship between preventive functions, emotional control, directing in behavior regulating dimension, functions of starting and supervision in meta-cognitive dimension depression disorder. Discussion: It seems that brain executive functions are different in girls and boys because of shared activity of this region with cortical and sub cortical regions, anatomical substructures and dissimilar growth processes of the brain in girls and boys. Since we can trace some cognitive emotional disorders in depression, most of executive functions are associated with depression.

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Introduction

Executive functions express high level cognitive processes which are results of mutual activities of pre-frontal lobe, cortex, and sub cortical regions of the brain (Miller, 2007). According to comprehensive theory of executive functions, functions are included of organization, planning and supervision. These functions lead to self-awareness, self-care and aimed behavior through management of basic cognitive processes, matching between task demands and potential capabilities and also emotion controls (Meltzer, 2007).

Some studies have shown neuropsychoinventoryical differences such as dissimilarity in growth processes of different parts of brain and also different anatomical structures of brain in girls and boys (Kimora, 2004; Bergland, 2010). In some theories gender differences in cognitive processes is a principle. Pass theory which developed by Naglieri & Das (2001) is about understanding and predicting gender differences in basic cognitive processes such as attention, planning, simultaneous and successive processes. It suggests that girls are

better in processes of attention and planning than boys but there is no difference between girls and boys in simultaneous and successive processes (Naglieri et al. 2001; Bardos et al. 1991). Rabbi Case (1992) as one of followers of evolutionary system of data processing in theory of mind module suggests that the most important evolution in cognitive processes in childhood is ripening and using executive functions. He expresses bioinventoryical ripening and specific experiences are effective on executive functions. Since, children are engaged in the environment with various experiences, significant differences of executive functions in intrapersonal and interpersonal levels can be expected.

As above mentioned, it is expected that executive functions are different in girls and boys. Also, since executive functions are medium of communication between separate regions in frontal region and other regions of the brain, executive inefficiencies can be associated with mental disorders particularly disorders which lead to serious damages in cognitive and emotional fields such as depression.

According to diagnostic and statistical manual of mental disorders (DSM-V) emotional-cognitive symptoms are among main symptoms of depression disorder. Welse and Matius (1996) in theory of ordering executive functions express that the method of executive functions is associated with mental hygiene and adoptability of person (Moos, 2009). Thinking about dangers, inability in controlling and managing thoughts, cognitive confidence, necessity of severe cognitive control and self-awareness are expressed factors in this theory which are associated with mental disorders.

Studies have shown that childhood depression disorder is accompanied with cognitive deficits and inefficiency of guiding factors of cognitive processes (Watkins, 2001). It is proved that prefrontal region of the brain and structures of limbic system such as Amygdala are effective in emotional symptoms of depression disorder in childhood.

Imaging studies have shown the structural differences between brains of healthy children and brains of children suffering from depression: lack of symmetry of prefrontal region of right hemisphere and left hemisphere in depressed people and also the difference in volume of frontal piece of healthy and depressed people (Hankin et al., 2008).

One of important dimensions of current study is comparative analyzing of executive functions because of etiology of cognitive and behavioral differences in two genders. Another important dimension is etiology and phenomenology of mental disorders especially depression disorder for each gender. We can compile efficient approaches for clinical interventions through clarifying background risk factors of depression. However, determining the relationship of each executive functions can help to choose a particular therapy method for decreasing depression symptoms.

Methods

The sample includes 1200 students (600 girls, 600 boys) of elementary school who were selected through multi step cluster sampling from all of students of Tehran. Sample group of depression disorder includes 45 students (24 girls and 21 boys) who were selected from main sample group in method of availability through morbid symptoms questionnaire of children. Regarding entrance and exit qualifications of people into the research, it must be mentioned that all of participants were in depression sample group. Participants who had other mental disorders except depression and also participants, who had been recovered from other mental disorders except anxiety and obsession, were omitted from the sample. Tests were run individually in one session. Before the test, researcher taught the

concept of executive functions to parents and teachers in order to prevent misunderstanding.

Tools

Behavioral ranking inventory of brain executive functions (BRIEF): this questionnaire was compiled by Gioia et al. (2000) in two versions of "parent" and "teacher". We conformed and normalized the "parent" version in Iran. This questionnaire has been applied on 5-18 years children in both genders. There are 86 items in this questionnaire which evaluates executive functions in two dimensions of behavior regulation and metacognition. The dimension of behavior regulation demonstrates children ability in directing cognitions and adjusting emotions and behaviors through suitable preventive actions; there are functions such as directing, emotion control and preventive functions in dimension of behavior regulation. Dimension of metacognition represents children ability in supervising on personal activity and self-management. Starting functions, active memory, planning, organization and supervision are evaluated in metacognition dimension. Items must be responded as never (1), sometimes (2) and most of the time (3).

According to designers of questionnaire, it is highly reliable. Internal consistency has been calculated in domain of 0.80-0.98 through Cronbach Formula for eight executive functions, behavior regulation index and metacognition index. The reliability of conformed questionnaire in Iran was in domain of 0.80-0.97 for small scales through dividing 0.82 and calculating Cronbach. Content validity of questionnaire was reported high and structure validity was 0.50 and 0.64 through determining correlation between preventive index and retreation index to CBCL Test and active memory index with attention problems in CBCL Test, respectively.

(2) Questionnaire of Children symptoms inventory (CSI): it was designed by Geddow and Sperfekin (1994) as a screening tool for behavioral, affective and cognitive symptoms. The items of this questionnaire is as similar as DSM and includes 112 items in 4 scales (never=0, sometimes=0, often=1, most of the time=1). Some mental disorders such as depression disorder, conduct disorder and etc. is diagnosable through it. The method of scoring is on the basis of screener cut. Validity and reliability of the questionnaire has been reported with sensitivity of 90% for depression disorder through K-Sade-E interview. In a study by Tavakolizadeh (1375) the sensitivity of questionnaire on the basis of cut scores 7,5 and 4 for attention deficit-hyperactivity, obsession and depression was 75%, 89% and 89%, respectively. The sensitivity of questionnaire on the

basis of above mentioned cut scores for specifications of disorders was 92%, 91% and 97%, respectively.

(3) Findings: in order to describe the study data, it was used of statistical indices of mean and standard deviation for eight executive functions, index of behavior regulation, metacognition index and total scores of executive functions in both genders. As table 1 shows mean scores of girls are higher than boys in all of small scales of executive functions except small scale of emotion control. Also, score of behavior regulation and Meta-cognition indices are higher in girls than boys.

Results of comparison executive functions in girls and boys through variance equality test and F test of two independent groups are as following (table 2).

The results of t-test of both genders were as the following:

inhibit ($t=7.32$; $\alpha=0.01$)

shift($t=9.39$; $\alpha=0.01$)

Emotional control ($t=10.5$; $\alpha=0.01$)

initiate($t=8.40$; $\alpha=0.01$)

working memory($t=8.42$; $\alpha=0.01$)

Planning ($t=7.51$; $\alpha=0.01$)

Organization ($t=8.73$; $\alpha=0.01$)

monitor($t=7.51$; $\alpha=0.01$)

Index of behavior regulation ($t=7.70$; $\alpha=0.01$) and meta-cognition ($t=9.05$; $\alpha=0.01$)showed that there was a significant difference between all above mentioned functions in both genders. Referring to mean scores of executive functions demonstrated that preventing, directing, starting, active memory, planning, organization and supervision scores of girls are higher than boys; just emotional control function in dimension of behavior regulation in boys has higher mean than girls.

In order to analyze the relationship between executive functions and depression disorder in girls and boys, we used Pearson correlation statistical test (table 3). The results showed that there was a significant negative relationship between inhibit ($r=-0.41$, $\alpha=0.01$), shift ($r=-0.44$, $\alpha=0.01$), emotional control ($r=-0.53$, $\alpha=0.001$) in dimension of behavior regulation and initiate ($r=-0.33$, $\alpha=0.001$) and monitor ($r=-0.50$, $\alpha=0.001$) in meta-cognition dimension with depression disorder. The results were relatively similar for boys and girls.

Table 1: calculating mean and standard deviation of executive function scores and its small scales for girls and boys

gender	girls			boys		
	quantity	mean	Standard deviation	quantity	mean	Standard deviation
Executive functions						
inhibit	600	35.79	6.79	600	32.28	
shift	600	29.08	5.03	600	26.13	
Emotion control	600	14.51	4.50	600	17.18	
initiate	600	17.12	6.63	600	15.31	
Working memory	600	26.64	5.12	600	24.15	
Planning	600	23.67	6.07	600	30.49	
Organization	600	16.99	3.34	600	15.15	
monitore	600	25.84	4.77	600	23.60	
Behavior regulation	600	79.39	7.48	600	75.60	
Meta-cognition	600	120.35	20.58	600	108.55	
Executive functions (totally)	600	199.80	27.24	600	183.98	

Table 2: comparison between small scales mean of executive functions in girls and boys

Statistical indices		mean	variance	SD	Variance s equity test	Meaningfulne ss level	t-test of two independe nt groups	Freedo m degree	Meaningfulne ss level
inhibite	Girls	35.79	46.10	6.79	24.17	0.01	7.32	1174.84 9	0.01
	boys	32.28	10.06	7.75					
shifting	Girls	29.08	25.20	5.02	22.59	0.01	9.93	1172.85 6	0.01
	boys	26.13	33.75	5.81					
Emotional control	Girls	14.51	20.25	4.50	4.48	0.01	10.05	1196.09 2	0.01
	boys	17.18	31.99	4.69					
initiate	Girls	17.12	43.95	6.63	15.48	0.01	8.40	1192.67 9	0.01
	boys	15.31	14.51	3.81					
working memory	Girls	26.64	26.21	5.12	32.38	0.01	8.42	1158.40 6	0.01
	boys	24.15	36.72	6.06					
planning	Girls	33.67	36.84	6.07	31.48	0.01	8.73	1173.14 3	0.01
	boys	30.49	47.88	6.92					
organizatio n	Girls	16.99	11.15	3.34	34.91	0.01	7.51	1164.59 4	0.01
	boys	15.15	15.36	3.92					
monitor	Girls	25.84	22.75	4.77	22.74	0.01	7.51	1169.37 2	0.01
	boys	23.60	30.14	5.49					
Behavior regulation	Girls	79.39	55.09	7.48	56.02	0.01	7.70	1126.84 4	0.01
	boys	75.60	88.05	9.41					
Meta- cognition	Girls	120.3 5	426.53	20.5 8	41.35	0.01	9.05	1154.12 3	0.01
	boys	108.5 5	584.17	24.1 8					

Table 3: the relationship between executive functions and depression disorder

Statistical indices	girls			boys			sum		
	quantity	meaningfulness Index	meaningfulness Level	quantity	correlation Index	meaningfulness Level	quantity	correlation Index	meaningfulness Level
prevention depression	24	-0.41	0.001	21	-0.40	0.001	45	-0.41	0.001
directing depression	24	-0.45	0.001	21	-0.44	0.001	45	-0.44	0.001
Emotion control depression	24	-0.55	0.001	21	-0.52	0.001	45	-0.53	0.001
starting depression	24	-0.36	0.001	21	-0.32	0.001	45	-0.33	0.001
Active memory depression	24	-0.08	0.442	21	-0.05	0.425	45	-0.07	0.325
planning depression	24	-0.36	0.018	21	-0.35	0.015	45	-0.07	0.011
organization depression	24	-0.02	0.851	21	-0.08	0.650	45	-0.06	0.06
supervision depression	24	-0.54	0.001	21	-0.44	0.001	45	-0.50	0.001
Behavior regulation depression	24	-0.47	0.001	21	-0.45	0.001	45	-0.44	0.001
Meta-cognition depression	24	-0.46	0.001	21	-0.44	0.001	45	-0.43	0.001

Discussion

Executive functions in dimension of behavior regulation displays person ability in directing cognitions and changing emotion through suitable preventive functions; although girls are better than boys in directing, attention and preventive functions but boys are better in emotional control functions than girls. Barkley (2002) speaks about preventive function as the most important function and believes that other functions and also brain executive system are dependent to preventive functions (Barkley, 2006). Results show that there is little difference between girls and boys in preventive function. Since preventive function is effective on emotional control and attention directing, it can be interpreted that preventive function leads to keeping attention during activities in girls and management and moderation of emotions in boys. On the other side, prefrontal lobe is responsible for applying executive functions through shared activities with other cortical and subcortical regions. It seems that this supposition is true because there are different growth processes and dissimilar anatomical structures in cortical and subcortical

regions of girls and boys (Janzen, 2003). For example, since shared activity of prefrontal lobe with basal ganglia is effective on directing function, it can be said that priority of girls is associated with early growth of basal ganglia in girls (3 years earlier than boys) shepherd (1999). The priority of boys emotional control function is result of network interactions between prefrontal lobe and amygdale. This region is evolved until before 18 years in boys. Meta-cognition dimension represents person ability in supervision on personal function and self-management which is included organization, planning, starting, active memory and supervision. Results show that girls are better than boys in functions of metacognition subcategory. Neuropsychological studies state that there is some dissimilarity between nervous networks and structures in different regions of brain in girls and boys. For example Corpus Callosum with links two brain hemisphere is more condensed in girls. This region in girls is more grown (40%) than boys (Casper, 1998). Condensation of white matter in Corpus Callosum leads to acceleration of nervous

transferring between prefrontal lobe of both hemispheres and cortical and subcortical regions of them. Therefore, it is hypothesized that functions such as active memory, organization and planning which need nervous movements and transferring between two hemispheres are better in girls than boys. Results of current study confirm this hypothesis.

Supervision function is result of ability of evaluating personal function; starting function includes producing thinking and presenting approaches of problem solving. These two functions are related with structuralization of grey matter in prefrontal lobe of brain. Thus, since this region is evolved at 12.1 years in boys and at 11 years in girls, it is expected that girls in age domain of 7-11 years (the sample in current study) are better than boys in these two functions. Results of current research confirm this hypothesis.

Hippocampus which is one of main centers of active memory is responsible for managing memory processes through shared activity with prefrontal lobe. Girls are grown up earlier than boys in memory processes. Thus, it can be said that priority of girls in active memory function is attributed to fast growth process in their brain in comparison with boys (Strenburg, 2009). Finding of this study is in agreement with other studies in this field (Rojan et al., 2001; Dehan, 2003; Helper et al, 1998; Hehrer, 2009; Merith et al, 2007).

Second part of current research dealt with analyzing the relationship between executive functions and depression disorder and its findings show that there is a significant negative relationship between some functions and depression disorder. For example functions which are subsets of behavior regulation dimension have are associated with depression disorder; emotional control function has highest correlation. Studies have shown that children, who are suffering from disorder in emotional control, have problems in moderating emotions and managing emotional conditions. Since according to DSM-V mood and emotional symptoms are among main symptoms in depression disorder, it can be associated with bad function of emotional control. Cognitive and behavioral preventions are symptoms of depression disorder in childhood which is appeared as inability in interrupting unadoptable and negative cognitive flows, withdrawal and isolation periods and inability in all of these periods. Continuing unadoptable negative thoughts and beliefs as well as lack of preventive function are signs of children's problems in directing and supervision functions. These children confront with difficulty in directing and not paying attention to negative thoughts, controlling the content and thought processes (Moos,

2009). Findings of current research show significant relationship between preventive, directing and supervision functions with depression disorder in childhood. Among motivational symptoms of depression disorder are lack of interest to activities and in serious conditions inability in decision making and mental-movement retardation. These symptoms are associated with bad performance of starting function.

Findings of this study about executive functions and depression disorder are in agreement with other studies such as Fava et al. (2002), Lockwood et al. (2002) and Leplow et al (2005).

This study showed the difference in executive functions of girls and boys and relationship between some functions with depression disorder. The roles of factors such as age domain of sample group and effective cultural-social factors and etc which can change the interpretation of findings must be considered. Considering neuropsychological evidences meta-cognitive failure models in depression disorder, it seems that the identity of this disorder must be under interpretation and review. Because, most of psychologist have believed that it was just unadoptable beliefs and thoughts responsible for incidence of depression disorder. But new findings make us to go forward: it seems that meta-cognitive factors and executive functioning have effects on intellectual content and processes.

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