The effect of inhibitory-concentrative exercises on increasing mathematics skills among girls with ADHD

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ABSTRACT

The purpose of this research was to investigate the effect of inhibitory-concentrative exercises on improving mathematics skills among girls with ADHD in elementary schools in grade 2 from Tehran city. The method of this research was semi-experimental and pretest-posttest with control group design. Fourteen girls with ADHD, after screening, were randomly assigned in experimental and control group. For screening girls with ADHD was used to CSI-IV, diagnostic clinical interview based on DSM-IV-TR, and Raven’s intelligent test. Participants were completed Iran-Key math scale in pretest and posttest. For data analyzing was applied MANCOVA test. The results showed that inhibitory-concentrative exercises lead to improving mathematics skills and concentration in female ADHD (sig<.05). So that it can be suggested to trainers, psychologists, counselors and parents of ADHD children use the inhibitory-concentrative exercises for improving levels mathematics skills (Counting, summation, substraction, measurement, problem solving, interpretation and geometry)

Key words: Inhibitory-Concentrative Exercises, ADHD, mathematics skills.

Introduction

Mathematical ability includes calculation skills considering expected level of education and intelligence of child. The primary abilities in mathematics include: counting the numbers, comparing the quantities, numbers recognition, math computations, problem solving and etc. In fact, individuals use semantic, procedural and visual-spatial memory when performing mathematical computations [21]. In order to retrieve fundamental mathematical facts, individuals must use their semantic memory and this leads to data decoding in long term memory. Visual-spatial processing also leads to reduction of mathematical errors. Working memory has important role in mathematical computations, attention and processing speed. Attention deficits lead to serious problem for children who suffering from attention deficit / hyperactivity disorder (ADHD) [12]. ADHD is one of the most common disorders among children and adolescents that produce many problems for them. This disorder impacts cognitive, social, emotional and family functioning of children and may continue during adulthood, it impairs their job performance and sexual function [13]. This disorder emerges during early childhood and before 7 years old and it has a comprehensive nature and it cannot be regarded as only a neurological-cognitive, sensorimotor or emotional disorder.

Concentrative-inhibitory exercises are made based on inhibitory functions. Inhibitory functions are part of executive. Executive functions are critically important in the overall neuropsychological functioning of the developing child and play a fundamental role in the child’s cognitive, behavioral, and social-emotional development [20]. Executive function is generally used to refer to a set of abilities such as problem solving ability, attention, working memory, inhibitory control, impulsive control, set maintenance and set shifting. These abilities enable people to plan, initiate and carry through goal directed behavior in organized and ‘thought out’ ways [19].

Cognitive-behavioral treatments are based on the belief that cognitions, feelings and behaviors have an interactional nature, so that this approach has high compatibility with the needs of individuals who suffering from ADHD. Studies showed that cognitive disorders could be determined ADHD and are a strong base for development and extension of therapeutic-cognitive approaches [3].

Various cognitive-behavioral treatments have been applied for children suffering from ADHD. These treatments are focused on executive functions in order to enhancing self-control and attention [14]. Barkley [6] has developed a theory concerning
attention deficit and hyperactivity disorder which has important implications for designing and executing cognitive-behavioral therapeutic strategies. He believes that ADHD indicates a disorder in response inhibition. In other word, Barkley states that children who suffering from ADHD have a main deficit in behavioral inhibition that has a negative and inhibitory effect on the activity of 4 executive functions; These functions are: a) autonomy of working memory, b) autonomy of emotions, motivation and excitation, c) autonomy of inner speech, and d) reconstruction of memory. High percent of children with ADHD haveweak educational performance. Most of these children have problems in mathematics due to the deficits of attention and concentration. The most important established method in ADHD treatment is developing and maintaining a suitable cognitive behavior therapy (CBT) and drug therapy [27]. Furthermore the studies of DannielMarse et al [8], Fisher et al [11], Dowson Guire [9], Willcont et al [26] indicated that teaching executive functions is effective in reduction of hyperactivity symptoms. Swanson and German [25] in a meta- analysis on the literatures concerning mathematics learning disability stated that those who have math disability compared to normal ones have significantly weaker performance on verbal working memory, working visual-spatial memory and long term memory. Ghamarigivi, Narimani and Mahmoudi [22] demonstrated that application of cognitive progressive software has a positive impact on enhancement of working memory skills and inhibition of response in ADHD children. In another study based on Barkley’s model that conducted by Nosratabadi, Alilou, Sougitapeh and Rostami [22] showed that presence of primary deficits in executive functions and behavioral inhibitions among children with dominant hyperactivity impulsivity is more than that in children suffering from dominant inattention. Also Abedi and Agha Babaei [1] showed that working memory training can be used as an intervention method for improving math problems of students who suffer from math learning disability.

The final goal of treatment of children who suffer from ADHD is to make them able to face with problems. This goal is not achievable through drug therapy or forcing them to follow the principles, but an important way to obtainability this goal is to teach some solutions about behaving with people and the duties that are useful in their daily performance. In present study our purposeis to determine the effect of teaching inhibitory-concentrative exercise on increasing math skills (Counting, summation, subtraction, measurement, problem solving, interpretation and geometry) levelsamong female with ADHD.

Materials And Methods

Statistical population of present research includes female students of second grade on primary school in Tehran during 2012-2013. The sample was randomly selected via multi-stage cluster method. The method ofthis research was to semi-experimental with pre-test and post-test and control group design. After screening and identification of ADHD children based on CSI-4 test and diagnostic clinical interview based on DSM-IV-R, and Rion’s intelligent test; they are randomly assigned in control and experimental group. For estimation of sample size, is used to Cohen’s table (with α=.05 and power of test=.80) and 7 participants in per group were studied by researchers [24].

Research tools:

Children’s somatization inventory (CSI-4):

This inventory was firstly developed by Sperafkin, Galo (1984, quoted from Hatavi and Barkley, 2003) in order to screen behavioral and emotional disorders of children aged up to 12 years old and then applied it for evaluating ADHD children. This questionnaire has two inventories: parents’ investigation (112 items) and teachers’ investigation (87 items) which is answered based on Likert’s four points scale. 18 items of this questionnaire evaluate attention deficit and hyperactivity disorder and next 18th items evaluate hyperactivity- impulsivity symptoms. Sperafkin and Grou (1994, quoted from Skers et al, 2004) reported the reliability of this questionnaire .70 to .80. ALipour and Mohammad Esmaeiel reported test-retest reliability of test .90. In present research, the internal consistency reliability of test was obtained .77 and content validity of this test was confirmed by specialist.

Clinical diagnosis interview based on DSM-IV:

In order to accurate diagnosis of children with ADHD we used clinical diagnostic interview based on DSM-IV-TR criteria, in which parents and teachers were asked several questions, in this regard. Based on results of this interview students who have other mental disorders (psychotic, learning disorders etc.) were removed.

Raven’s intelligence test:

This test was prepared in Britain for measuring Spearman’s general intelligence factor (g). Revised forms of this test are applied for measuring the intelligence of children (5 years old and more).this test has internal-consistency reliability.80-90. The correlation of this testwith Weksler’sverbal intelligent was reported .73 [23].

Key-Mathmathematical scale:
This test was designed and normalized by Connely [7]. This measure has extensive application in identification of students who have math learning disorders. Also this test was applied for determining the abilities and weaknesses of students in different fields of mathematics. Chi-Math test can be used for first to fifth grades students of elementary school. Iran’s Chi-Math mathematics scale was translated, adjusted and normalized for evaluation of 5, 6 to 12 years old children. This test was used in 11 provinces of Iran in 6395 students [10]. In present study, the internal consistency reliability (Chronbach’s alpha) of this test was obtained 0.84. Score of this test divided into four areas that are:

1. Basic Concepts: counting, rational numbers.
2. Operation: subtraction, multiplication, division and mental calculation.
3. Implication: measuring time and money, and the estimation and problem solving.
4. Analysis: interpretation of data and the geometry.

Steps of administration:

1. Students observed for probability identification of ADHD.
2. Teachers and parents completed CSI-4 questionnaire about students who were selected in previous step, and students who had highest score on disorder symptoms were screened for participation in the test.
3. The Rion’s intelligent test was completed by students who were selected in second step for making sure of presence of their normal intelligence.
4. Doing clinical diagnostic interview based on DSM-IV-TR with parents in order to distinguish the subjects who suffer from other mental disorders (psychotic, learning disorders etc.) and withdrawal them.
5. Administration of Chi-Math (pretest) on experimental and control groups.
6. Offering independent variable (inhibitory-concentrative exercises) in 8 sessions. In these sessions we emphasized on:
   A. A short explanation and seeking of auditory information.
   B. Rapid communication with them in order to increase their motivation for participate in sessions.
   C. Displacement of numbers, repeating of negative words.
   D. The reverse spelling of words, the number of points in a word, opposite inverted repeat numbers.
   E. Counting, mental subtraction, and mental summation.
   F. Visual inhibition, visual acuity, discrimination of figure in a visual context.
   G. Auditory attention, auditory discrimination, auditory memory, retrieval and seeking of auditory information.
7. Administration of Key-Math (posttest) after offering independent variable in two groups.

Results:

<table>
<thead>
<tr>
<th>Table 1: descriptive statistics of math skills components</th>
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<tbody>
<tr>
<td>Group</td>
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<tr>
<td>-------</td>
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<tr>
<td>Exp</td>
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<td>Cont</td>
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<td>Cont</td>
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</tbody>
</table>

Statistical indices, according to above table, show distribution of all math skills components tended toward normal in pre and post-test scores in two groups (the skewness and kurtosis are on +2 and -2 distance). In this research higher scores in components of math skills test are an indicator of higher errors in this test.

Data analysis:

Hypothesis: inhibitory-concentrative exercises effect on components of math skills in second grade ADHD girls.

To test of the hypothesis was used MANCOVABefore using this test we considered assumption of this test, such as homogeneity of variances and covariance, and correlation between levels of dependent variable. Pearson correlation between components of math skills showed that in all cases the correlation between dependent variables levels is very strong and significant (Sig < ./.1). The results of Box’ test indicated that there are the homogeneity of covariance matrix in groups (sig= 0.829, df=.88, 478, F=.581). Also The results of Levine’s test indicated that there is homogeneity of variance in the all components of math skills in groups (Sig=.915, df=1, F=.012).
According to above table, based on tests of Pillai’s trace, Wilk’s Lambda, Hoteling’s trace, Roy’s greatest root could be said the effect of group on the math skills components is significant and it can be stated the difference of combination of dependent-variables in groups is significant. As a result, there is a significant difference between math skills components in children with ADHD and control group in this study. The results test of between subjects effects for the evaluation the impact of each dependent variable are given in table 3, separately.

### Table 3: Test of Between-subjects Effects

<table>
<thead>
<tr>
<th>dependent variables</th>
<th>Sum of Square</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
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</thead>
<tbody>
<tr>
<td>concept</td>
<td>50.88</td>
<td>1</td>
<td>50.88</td>
<td>52.39</td>
<td>.000</td>
<td>.90</td>
</tr>
<tr>
<td>operation</td>
<td>31.39</td>
<td>1</td>
<td>31.39</td>
<td>11.11</td>
<td>.016</td>
<td>.65</td>
</tr>
<tr>
<td>application</td>
<td>48.86</td>
<td>1</td>
<td>48.86</td>
<td>66.44</td>
<td>.000</td>
<td>.92</td>
</tr>
<tr>
<td>analysis</td>
<td>81.50</td>
<td>1</td>
<td>81.50</td>
<td>43.14</td>
<td>.001</td>
<td>.88</td>
</tr>
</tbody>
</table>

As shown in table 3, the between-groups differences in math skills components are significant (P<0.05). Partial Eta square shows that the variable variance of component of application is predicted higher than other variables by the group factor. In addition to this variance, operation is little predicted than other variables in the group factor.

**Discussion And Conclusion:**

Based on the findings of this research concluded that inhibitory-concentrative exercises lead to improve student’s math skills. In other words, the levels of math skills such as counting, summation, subtraction, measurement, geometry, problem solving and interpretation are improved by inhibitory-concentrative exercises. It can be said inhibitory-concentrative exercises impact executive functions and improve working memory performance. These results are consistent with the findings of DannielMarse et al [8], Fisher et al [11], Goldberg et al [14], Dowson Guire [9], Willcont et al [26], and Barkley [6], and who have investigated the inhibitory exercises role in working memory and self-control.

It seems that inhibitory-concentrative exercises effect on working memory performance. One of important working memory roles is its help to controlling attention (selective and divided attention), determining which stimuli are selected for focused attention. Attention may play an integral function in working memory. Therefore inhibitory-concentrative exercises can improve executive functions, working memory act for information processing and controlling attention. According to findings of this research, it is recommended to psychiatriists, parents and teachers use inhibitory-concentrative exercises for improving math skills (such as concepts, operations, applications and analysis). It is suggested that the other researchers investigate the effects of inhibitory-concentrative exercises on executive functions components such as programming, organizing, and sensitivity to time. They can also investigate males with ADHD, in this regard.

**References**