Improving the Dictation in Attention Deficit Hyperactivity Disorder by Using Computer Based Interventions: A Clinical Trial

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Objective: The aim of the current study was to assess the impact of computer games and computer-assisted type instruction on dictation scores of elementary school children with attention deficit – hyperactivity disorder (ADHD).
Method: In this single-blind clinical trial, 37 elementary school children with ADHD, selected by convenience sampling and divided into group I (n=17) and group II (n=20), underwent eight one-hour sessions (3 sessions per week) of intervention by computer games versus computer-assisted type instruction, respectively. 12 school dictation scores were considered: 4 scores pre-intervention, 4 scores during interventions, and 4 scores post-intervention. Dictation test was taken during each session. Data was analyzed using repeated measure ANOVA.
Results: Two groups were matched for age, gender, school grade, medication, IQ, parent's and teacher's Conners' scale scores, having computer at home, history of working with computer, and mean dictation scores. There was no significant difference in dictation scores before and after interventions and also between the study groups. The improvement in school dictation scores had no significant correlation with age, gender, Ritalin use, owning a computer at home and past history of computer work, baseline dictation scores, Ritalin dose, educational status, IQ, and the total score of parent's and teacher's Conners' rating scale.
Conclusion: Absence of significant improvement in dictation scores in study groups may be due to the confounding effect of other variables with known impact on dictation scores. Further studies in this field should also assess the change of attention and memory.
Keywords:
Attention deficit disorder with hyperactivity, Child, Computer, Educational status, Controlled clinical trials

Iran J Psychiatry 2006; 1: 123-127

Attention deficit – hyperactivity disorder (ADHD) is a prevalent disorder in children affecting 6% of them (1). The diagnosis is made increasingly in children (2); from 19 cases per 1000 in 1990 it has reached to 59 cases in 1000 in 1998 (3).
A considerable number of children with ADHD have poor educational functioning (1, 4, 5) of which doing poor at dictation is a main cause their weakness or even failure (6). Spelling and writing skills of these children is less good than the normal population (7). Without intervention, the poor dictation scores of these children do not improve, less so in children who have lower scores (8). In many cases, the dictation scores do not improve even with intervention (9). Nevertheless, efforts to increase the dictation scores of children with ADHD are considered as a suitable field for clinical trials.
Although the stimulants have led to improvement in some aspects of educational function of children with ADHD (writing, calculation and the ability to participate in examination), the educational performance of some of them doesn't improve with medication and probably it needs special interventions (1,6). In two clinical trials which used methylphenidate and evaluated the dictation scores as a consequence, only in one study the scores had improved (10, 11).
There are some evidence on ineffectiveness of long-term training of dictation by parents on dictation scores. Not to mention that in many families, direct training of children by parents is impossible, and parents' dictation is not good (9). All these emphasize the necessity of using interventional methods.
In some of these interventions, computer is used (12, 13, 14, 15, 16, 17). For example, in one study children responded by using the keyboard while the letters and words were shown to them on the monitor (12). In another study, first some words were shown to children on the monitor and then they were asked to copy those words in writing. In the next stage, they typed the words

from their memory (15). In some of these studies, there was no improvement in spelling after such instruction.

The impact of instruction by computer on spelling in normal children (17), spelling disabled children (16-19) and neurologically impaired children has been investigated. Although the results differ, some of them are satisfactory (20).

So far, and to our knowledge, the impact of computer-assisted instruction on improving dictation scores of children with ADHD has not been evaluated (18).

There is some evidence confirming that attention of children increases after utilizing computer games (9, 21 & 22). In this study, we used computer games and computer-assisted type instruction as two interventions to investigate the impact of computerized intervention on dictation scores of elementary school children with ADHD.

Materials and Methods

In this single-blind randomized clinical trial, 37 children with ADHD were investigated. The children were selected through convenience sampling. All of them were outpatients at Roozbeh Hospital clinic or referrals from private child and adolescent psychiatry clinics in Tehran, in winter 2005. Inclusion criteria were: 1) diagnosis of ADHD for more than one year, and 2) studying in the second to fifth grades of elementary school. As the first grade elementary school students have not learnt spelling completely, they could not participate. Exclusion criteria were: 1) Learning disabilities (according to the diagnosis of the psychiatrist by interviewing with parents, evaluating the scores and history of the child, 2) Coexisting acute-phase psychiatric disorders (major depressive disorder and bipolar disorder), and 3) IQ<70 (based on Raven IQ test). Controlled major depressive disorder and bipolar disorder (under treatment) and tics disorder were not considered as exclusion criteria. Written informed consent was obtained from all parents.

Children were non-randomly divided in two groups. 17 children were in group I (computer game) and 20 children were in group II (computer-assisted type instruction). Computer-based instruction were done by a general practitioner. All children were requested to continue their computer tasks at home.

Demographic factors (including age, gender and educational status), medication history, having computer at home, and history of working with computer were registered through interviews with parents by a general practitioner. The severity of core symptoms of ADHD was measured by parent's and teacher's Conners' rating scale. IQ of children who were at second and third grades elementary school were determined by the colored Raven test; and the black and white Raven test was used for forth and fifth grades elementary school children. The results of this test were interpreted by a psychologist.

The intervention consisted of eight one-hour sessions, which were held every two days in Roozbeh Hospital, Psychiatry and Psychology Research Center, in winter 2005. The school and the sessions' dictation scores of the children were evaluated. Twelve school dictation scores (4 basic dictation scores for one month before the interventions, 4 scores for one month during the interventions, and 4 scores for one month after interventions were obtained from all of children.

At the end of each session, a general practitioner dictated 20 words from the words of the last lesson learnt by the student at school. Therefore, 8 session's dictation scores were obtained. This was done in order to record the change. This dictation was paper-based, and the dictation corrector was masked to the groups.

The second intervention was type instruction by a computer program (Ava type, Iran). The program was provided on a CD and was instructed at each session. It included the instruction on main keys of the keyboard (two sessions), the upper row keys and lower row keys of the keyboard (two sessions), number keys (one session) and the remaining keys (three sessions). Total training time was 40 minutes per session. First, the children practiced the letters for 10 minutes. The letters were then displayed on the monitor and the responses were made by clicking on the same letter on the keyboard. Then they practiced the letters competitively for 10 minutes and after that they went practicing the sentences for 10 minutes—the sentences were shown randomly and the children typed them on the keyboard.

If the child typed the sentence correctly, the next sentence was displayed. In the next stage, children competed with each other in typing the sentences.

In group I, the sessions of computer game lasted 40 minutes. Computer games consisted of Space War, Drive-by 2, Monster Bash, Monkey Hunt, Shoot the Melon, Beer Monster, Snow Throw, Snow Ball, Happy Land, Golden Gate, Conveyor, Save Golf Fish, Zanny Attack, Happy Lead and Bash Police Bike. Each child played one of these 15 computer games for two equal 20-minute periods. The child could select his/her favorite games.

In order to compare two groups on basic characteristics, we used χ^2 test, unpaired t-test and Fisher's exact test. Paired t-test was used for evaluating change in the dictation scores of the groups. The study power was 80%, the confidence interval was 95% and the sample size in each group, considering the 40% improvement in the dictation scores, was determined to be 20 subjects. $P<0.05$ was significant and $0.05<p<0.1$ was considered marginally significant. Analyses were done using the repeated measure ANOVA model by SPSS-11.5. In this model, we investigated the effect of the study group and repeated factor (dictation score before, during and after the interventions), and we measured the interaction between the study group and dictation score.

Results

Two groups were similar regarding age, gender, IQ, use of Ritalin and other drugs, school dictation scores before intervention, having computer at home, and the history of working with computer. Eighty two percent of children in group I (computer game) and 70%of cases

Table1. Comparisons of demographic, educational and psychiatric variables in two groups

Variable		Group I (game)	Group II (type instruction)	*P*
Age (year) (mean±SD)		(9.32±0.88)	(9.12±1.07)	ns†
IQ (mean±SD)		(103±13)	(110±12)	ns†
Conners' Rating Scale (Mean ± SD)				
Parent	Oppositional	(10.27±4.79)	(10.28±4.69)	ns†
	Inattention	(11.27±4.79)	(11.39±5.61)	ns†
	Hyperactivity	(10.20±5.19)	(11.00±4.79)	ns†
	ADHD	(22.80±7.91)	(24.00±7.75)	ns†
Teacher	Oppositional	(3.44±3.88)	(2.93±3.17)	ns†
	Inattention	(3.67±3.16)	(5.13±4.26)	ns†
	Hyperactivity	(9.33±7.48)	(8.47±4.64)	ns†
	ADHD	(15.44±10.86)	(16.67±7.27)	ns†
School dictation score one month before intervention (mean ±SD)		(17.20 ±3.26)	17.89±2.15	ns†
		Frequency (%)	Frequency (%)	
Drug History	Ritalin	10(59%)	11(55%)	ns†
	Fluoxetine	0 (0%)	1 (5%)	ns†
	Lithium	1 (6%)	0 (0%)	ns†
	Sodium Valporate	1(6%)	0(0%)	ns†
Having computer at home		Frequency (%) 3(17%)	Frequency (%) 9 (45%)	ns‡
History of working with computer		Frequency (%) 15 (90%)	Frequency (%) 14 (70%)	ns‡

†= unpaired t-test ‡ = χ^2 test ns= non significant

in group II (computerized type instruction) were male (P<0.05).The result of repeated measure ANOVA model showed no significant change of the dictation score during the intervention, and no significant difference between dictation scores of both groups. Also, the interaction term in the model was not significant, showing no significant change of the dictation score during the intervention in either of groups. Change of dictation scores during intervention in two groups is shown in Table 3.

The improvement in school dictation scores during intervention (computer game) in comparison with scores before the intervention, had no significant relationship with gender, Ritalin use, having computer at home, and history of computer work. Also according to the Spearman correlation coefficient, this improvement was not correlated significantly with age, primary scores, Ritalin dose, educational status, IQ, the total score of parent's and teacher's Conners' rating scale.

Discussion

This study was carried out for the purpose of comparing the impact of computer games and computerized type instruction on improving the dictation scores of elementary school children with ADHD. The results showed no change in the dictation scores during the intervention and also between the two groups.

In this investigation, computer-assisted type instruction did not result in any increase in dictation scores, reproducing results of some other studies (17, 25).

However, Stevens and colleagues' results are in contrast with our finding (12). One study revealed that teaching computer-based spelling to individuals with severe spelling problem and written language disorder causes improvement (20). Van Daal's study showed that computer-based reading and spelling practice were more effective than the paper-based one (15).

Despite our nonsignificant results, there is ample evidence regarding the impact of computer-assisted instruction on attention, learning and performance of children. Attractive educational environments and various software atmospheres can have positive effects on children with ADHD. Besides, computer programs increase attention of children (9, 21). According to a case–control study, attention of children with ADHD increased by attending a 12-hour computer game course (22). Decrease of aggressive behaviors and increase of attention and reading abilities after practicing with interactive metronome as an intervention are reported, too (23). There are also some evidences about the positive impact of computer games on cognitive rehabilitation in patients with ADHD (22). Support of decision making process and rapid feedback are two advantages of incorporating computer in children instruction. Computer games culminate in shortening of reaction time in children and working with them improves the information processing skills (13). In children with ADHD, sensorimotor training has caused amelioration in sensorimotor coordination and decrease in symptoms of hyperactivity and aggression (24).

Although we have similar studies in several patient

Table 2. Comparisons of the school dictation scores between two groups (before, during and after interventions)

Group (intervention)	**Before** (mean±SD)	**During** (mean±SD)	**After** (mean±SD)
Group I (computer game)	17.25±3.26	17.93±3.03	17.08±3.94
Group II (Computer assisted type instruction)	17.89±2.15	17.54±2.63	17.87±3.12

Table 3. Change of sessions' dictation scores during the intervention in two groups.(Group I, computer game; Group II, computer assisted type instruction)

Group (intervention)	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
Group I	18.55*±1.63	18.30±1.16	18.90±1.20	19.13±1.32	18.47±2.55	18.46±2.16	19.29±1.07	18.50±2.78
Group II	18.74±1.94	17.00±3.77	17.32±3.17	18.09±2.60	17.97±2.13	17.73±2.72	18.18±1.89	17.85±2.58

* All numbers are shown as mean ± SD.

populations, it seems that this research is the first study aiming at evaluating the impact of computer games on dictation scores in children with ADHD. Negative results of our study may be due to several confounders of dictation scores such as diversity of school grade, memory, attention, and also the unequal characteristics In other terms, instruction is not the only effective variable of children's educational function and the motive and ability of the teacher, and health of the child are also important (1). We supposed that another potential cause for this negative result may be the high baseline dictation scores of these children and the short length of the intervention.

If computer-assisted instruction could be effective, the results may be very promising, as these games are very simple and enjoyable for children (9). Moreover, nowadays, a significant proportion of children have computer in their houses. Those children, whose families cannot afford buying the computer, are able to use school's computers. So, computer availability can be considered a method of treatment.

In our study, improvement in dictation scores in group I (computer game) was just seen during the intervention period and scores after intervention came back to the level of pre-intervention. In another study which investigated the impact of spelling instruction through using computer in normal children, 3 months after the intervention, the scores came back to their primary levels, although in 20% of cases one month after the intervention, the spelling was better (17).

This is a primary study and— according to the literature— we believe that there is a great need for further studies with the aim of assessing the impact of computerized instruction to ADHD children. Such studies should block several confounders and should also address the change in ADHD symptoms, memory and attention. Such studies had better pay attention to this fact that improvement of dictation scores may be due to the practice effect during sessions (and not for the sake of computer games). The similarity of dictations in study groups can prevent this confounding effect in the obtained results.

Side effects of working with computer are: dependency, somatic signs and symptoms (e.g. articular problems), aggression, and social isolation. If the result of this study is confirmed, psychiatrists should be careful on selecting the computer games, because violent games have led to changes in insight and behavior of children.

In our study, intervention and follow-up course were short, and further studies with larger sample sizes, comparison groups, and longer course of intervention and follow-up are recommended. Also, studying such variables as attention, memory, and sensorimotor activities will determine the ways and mechanisms of improving spelling scores after computer games.

Acknowledgement

First of all, we would like to thank all children and their families for their kind cooperation. This study was supported by a grant from Tehran University of Medical Sciences. We gratefully acknowledge the contribution of Roozbeh hospital Psychiatry and Psychology Research Center and the Institute of Cognitive Science Studies.

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