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Research Paper

Effect of Aerobic Training on Verbal Working Memory, Cognitive Flexibility and Visual Perception in Patients with Written Disorder

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Abstract

Introduction: Written disorder is the highest and most complex language skill disorder in humans, and its patients often have problems in executive functions such as verbal working memory, cognitive flexibility, and visual perception. Therefore, the present research aimed to determine aerobic training on verbal working memory, cognitive flexibility, and visual perception in patients with the written disorder.

Methods: This study was quasi-experimental with a pretest, posttest, and one-month follow-up design with the control group. The research population was second and third-grade elementary students with the written disorder of Mashhad city in the 2018-19 academic years. The research sample was 24 participants who were selected by purposive sampling method and randomly with lottery replaced into two equal groups. The experimental group received 20 sessions of 45 minutes the aerobic training, and the control group did not receive any training. Data were collected using Stanford-Binet verbal working memory, Wisconsin cognitive flexibility, and Frostig visual perception tests and analyzed with statistical tests in SPSS software version 25.

Results: The results showed that the experimental and control groups in the pretest phase did not have a significant difference in terms of verbal working memory, cognitive flexibility, and visual perception ($P > 0.05$), but in the posttest and follow-up phases, there were significant differences in terms of all three variables ($P<0.05$). Also, aerobic training compared to the control group led to increased verbal working memory, cognitive flexibility, and visual perception in patients with written disorders. The results were maintained in the follow-up phase ($P < 0.05$).

Conclusions: According to the present study results, planning to use aerobic training and other training methods is essential to improve executive functions. As a result, professionals and therapists can use aerobic training to improve administrative processes, especially verbal working memory, cognitive flexibility, and visual perception.

Extended Abstract

OBJECTIVE

The written disorder is the highest and most complex language skill disorder in humans [2], and its patients often have problems in executive functions such as verbal working memory [3], cognitive flexibility [4], and visual perception [5]. Working memory is one of the most important cognitive processes and the basis of

thinking and cognition [7]. Verbal working memory is a type of working memory responsible for the stores and processes of oral information [9]. Also, cognitive flexibility is one of the executive functions of the frontal lobe of the brain, which is responsible for decision-making and cognitive control [10], which is defined as the ability to manage multiple aspects of a cognitive task simultaneously and refers to the ability to regulate of cognitive processes in the face of changing environmental goals and stimulus [11]. Also, visual perception is how visual information is analyzed, understood, and recognized and plays an influential role in learning [13]. Aerobic training is one of the most effective methods to improve executive function [15]. Aerobics consists of a combined set of principled, sequential, and regular movements performed with rhythm and music [16]. Little research has been done about aerobic training on executive functions, and sometimes the results have been different. Therefore, the present study aimed to determine aerobic exercise on verbal working memory, cognitive flexibility, and visual perception in patients with the written disorder.

MATERIALS AND METHODS

This study was quasi-experimental with a pretest, posttest, and one-month follow-up design with the control group. The research population was second and third-grade elementary students with a written disorder of Mashhad city in the 2018-19 academic years. The research sample was 24 participants who were selected by purposive sampling method and randomly with lottery replaced into two equal groups (each group 12 people). The inclusion criteria were included of having a written disorder based on a clinical interview, studying in the second and third grade of elementary school, moderate IQ based on a counseling record, not being rejected in previous years, living with parents, not having a psychological disorder and not consuming psychiatric drugs and exclusion criteria were included of non-cooperation or low cooperation in sessions, withdrawal from partnership and absence from more than three sessions. The experimental group received 20 sessions of 45 minutes the aerobic training, and the control group did not receive any training. Data were collected using Stanford-Binet verbal working memory, Wisconsin cognitive flexibility, and Frostig visual perception tests and analyzed by methods of independent t-test, repeated measures analysis of variance, and Bonferroni post hoc test in SPSS-25 software.

RESULTS

The results of the t-test showed that the experimental and control groups in the pretest phase did not have a significant difference in terms of verbal working memory, cognitive flexibility, and visual perception ($P>0.05$), but in the posttest and follow-up phases, there were significant differences in terms of all three variables ($P<0.05$) (Table 1). Also, the results of the repeated-measures analysis of variance and Bonferroni post hoc test showed that the aerobic training in compared to the control group led to increased verbal working memory, cognitive flexibility, and visual perception in patients with written disorders, and the results were maintained in the follow-up phase ($P<0.05$) (Table 2 and 3).

Table 1. The Results of t-test

Variables	Experimental Mean ± SD	Control Mean ± SD	P-Value
Verbal working memory			
Pretest	4.666 ± 1.302	5.666 ± 1.370	0.081
Posttest	8.250 ± 1.138	5.916 ± 1.240	0.001
Follow-up	8.08 ± 1.083	6.166 ± 1.114	0.001
Cognitive flexibility			
Pretest	1.416 ± 0.792	2.083 ± 0.996	0.083
Posttest	3.916 ± 1.378	2.000 ± 1.128	0.001
Follow-up	4.166 ± 1.642	2.250 ± 1.356	0.005
Visual perception			
Pretest	90.833 ± 4.987	90.916 ± 6.229	0.971
Posttest	98.916 ± 7.890	90.666 ± 6.984	0.013
Follow-up	104.333 ± 10.039	92.500 ± 6.735	0.003

Table 2. The Results of Repeated Measures Analysis of Variance

Variables	Mean of Squares	F	P-value	Eta Squared	Power
Verbal working memory					
Group	21.125	7.822	0.011	0.262	0.762
Time	45.617	35.093	0.001	0.615	1.000
Group*Time	30.053	23.119	0.001	0.512	0.999
Cognitive flexibility					
Group	20.056	6.629	0.017	0.232	0.692
Time	16.892	17.786	0.001	0.447	0.999
Group*Time	15.446	16.263	0.001	0.425	0.998
Visual perception					
Group	800.000	8.868	0.007	0.287	0.812
Time	347.598	9.722	0.001	0.306	0.974
Group*Time	228.343	6.387	0.004	0.225	0.876

Table 3: The Results of Bonferroni Post Hoc Test

Variables		Mean difference	Std.Error	P-Value
Verbal working memory				
Pretest	Posttest	-1.917	0.145	0.001
Pretest	Follow-up	-1.958	0.295	0.001
Posttest	Follow-up	-0.042	0.325	1.000
Cognitive flexibility				
Pretest	Posttest	-1.208	0.222	0.001
Pretest	Follow-up	-1.458	0.307	0.001
Posttest	Follow-up	-0.250	0.248	0.974
Visual perception				
Pretest	Posttest	-5.917	1.745	0.005
Pretest	Follow-up	-7.542	1.787	0.001
Posttest	Follow-up	-3.625	1.595	0.099

CONCLUSION

According to the present study results, planning to use aerobic training and other training methods is essential to improve verbal working memory, cognitive flexibility, and visual perception. As a result, professionals and therapists can use aerobic training to enhance cognitive features, especially verbal working memory, cognitive flexibility, and visual perception.

Ethical Considerations

This research has an ethics code with ID of IR.IAU.BOJNOURD.REC.1398.023 from Medical Ethics Committee of Islamic Azad University of Bojnourd branch. Also, in this study, the ethical protocol of Helsinki studies was performed, and the information of participants remained anonymous, and after the study, all this information will remain safe. Also, all participants stated the purpose, importance, and necessity of the research and signed the consent form of informed participation in the study.

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This research was conducted at personal expense and was not sponsored by any organization.

Author's Contribution

In this article, the first author was responsible for writing the proposal, implementing the intervention, collecting data and entering data into a computer. The second and third authors were responsible for the data analysis and article writing, and submission.

Conflict of Interest

At this moment, the authors declare that there is no conflict of interest between them.

Applicable Remarks

The present study was performed on patients with the written disorder who usually have executive functions such as verbal working memory, cognitive flexibility, and visual perception. The results showed that aerobic training increased verbal working memory, cognitive flexibility, and visual perception in patients with the written disorder. Therefore, due to the slightly different research background, specialists and therapists can be used from the results of this research as a new perspective in treatment policies to improve executive functions.

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