

Original Article



Comparison of Cognitive Rehabilitation and Floortime on Executive Functions in Children with Attention Deficit/Hyperactivity Disorder

Zohreh Ghasemi Mehrabadi¹, Sahar Safarzadeh^{2*}, Parvin Ehteshamzadeh², Zahra Daste Bozorgi²

¹Department of Psychology and Education of Exceptional Children, Ahv.C., Islamic Azad University, Ahvaz, Iran

²Department of Psychology, Ahv.C., Islamic Azad University, Ahvaz, Iran

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*Corresponding author:

Sahar Safarzadeh,
Email: s.safarzadeh1152@iau.ac.ir

Abstract

Introduction: The present study aimed to compare the effectiveness of cognitive rehabilitation and Floortime play therapy on executive functions in children with attention deficit/hyperactivity disorder (ADHD) in Tehran.

Methods: The statistical population included all children with ADHD in Tehran in the academic year 2023-2024. From the statistical population, 45 children with ADHD were assigned to two experimental groups and a control group (15 people in each group) (based on high scores on the Behavioral Rating Inventory of Executive Functions (BRIEF)). The research design was a quasi-experimental pre-test-post-test type with a control group and a two-month follow-up phase. The instrument used in the present study was the Behavioral BRIEF. Analysis of variance method with repeated measures and the Bonferroni post hoc test was used for data analysis.

Results: Cognitive rehabilitation and Floortime play therapy were effective on executive functions and their components compared to the control group ($P < 0.05$). There was a significant difference between the effectiveness of cognitive rehabilitation and Floortime play therapy in reducing executive function deficits in children with ADHD, and it seemed cognitive rehabilitation was more effective than Floortime play therapy ($P < 0.05$).

Conclusion: The cognitive rehabilitation method, compared to Floortime play therapy, can be used as a method to help improve the conditions of children with ADHD.

Keywords: Cognitive rehabilitation, Floortime play therapy, Executive functions, Attention deficit/hyperactivity disorder

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Introduction

Attention deficit/hyperactivity disorder (ADHD) is a psychiatric disorder characterized by a persistently decreased attention, increased impulsivity, and hyperactivity in children,¹ whose prevalence has been determined in various statistics from 1.7% to 2% of the population of each region, which affects an average of approximately 5% of children and adolescents worldwide and is associated with negative life outcomes and socio-economic costs.² Genetic factors make up 71% and 73% of the variance of inattention and hyperactivity symptoms, respectively.¹ Hassanzadeh et al. in 2019 showed that the prevalence of ADHD was reported to be 0.95% to 17% (average of 7.8%) of the population.³ These children experience various problems, including impairments in executive functions, which include impairments in behavioral indicators (inhibition, attentional switching, emotion control) and

cognitive indicators (initiation and working memory),⁴ so that research has shown that children (aged 12-16 years) with ADHD have poorer performance in some of the main executive functions,⁵ and these impairments can lead to multidimensional problems in their academic and social abilities.⁶ Robledo-Castro et al, during 2023, reported that children with ADHD have lower performance in activities that lead to inhibition.⁷ Cheng et al. also in 2024 showed that ADHD leads to difficulty in regulating and controlling some of the most important executive functions, such as failure in sustained attention.⁸ Effective psychological interventions in controlling the symptoms of ADHD include the cognitive rehabilitation program. This program is used to retrain or reduce deficits in attention, concentration, visual processing, language, memory, reasoning, problem-solving, and executive functions.⁹ Soleimani Oskuei et al. in 2022 showed that computer-based cognitive rehabilitation



exercises (including 12 sessions) with Captain Log software were effective in improving executive functions (working memory and visual problem solving) in 7- to 8-year-old children with ADHD.¹⁰ Nazerieh and Niknam in 2023 showed that cognitive rehabilitation exercises (including 12 sessions) are effective in the executive function of children with ADHD.¹¹ Floortime play therapy, based on individual differences and relationships, offers a solution to improve the child's psychological development that will lead to the strengthening of six basic developmental skills. These six skills are: self-regulation, interest in the world, intimacy, two-way communication, emotional beliefs, and logical thinking.¹² Wong and Qin in 2023 showed that child-centered play therapy (twelve 20-minute training sessions for three weeks) is effective on executive functions in children with ADHD.¹³ Floortime play therapy, by emphasizing behavior modification, emotion control, and engaging the child's senses through play in real nature and with an emphasis on family support, have been able to be effective in various ways on the conditions and status of children with ADHD. Therefore, in this study, as a new approach, two treatment methods were tested on children with ADHD to determine which method is better. Given that efforts to reduce the symptoms of ADHD in children can not only affect their executive functions, but also have a significant effect on the interpersonal quality of children. So, the purpose of the present study is to compare the effectiveness of cognitive rehabilitation and Floortime play therapy on executive functions in children with ADHD.

Methods

Sampling

Pre-test, post-test, and follow-up phase (methodology) and data collection with a questionnaire (quantitative) were used in this quasi-experimental research. The statistical population of this study included all children aged 8 to 12 years with ADHD who were referred to counseling and psychotherapy centers in Tehran, Iran (2023-2024) (based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria). Samples were determined based on the sample size in quasi-experimental studies. In the present study, 45 children with ADHD were divided into three groups: cognitive rehabilitation (6 girls and 9 boys), Floortime play therapy (7 girls and 8 boys), and control (5 girls and 10 boys). During the screening process, mothers answered the Behavior Rating Inventory of Executive Function (BRIEF), and 48 children who, based on the description of the measurement tool, had scored the highest on the BRIEF were identified. After that, post-tests were taken from the three groups to determine the durability of the effects of the treatment methods. Tests were administered again after two months. The inclusion criteria for the study included: a definitive diagnosis of ADHD by a psychologist or psychiatrist at the treatment center, parental consent, the absence of other psychological disorders, including the presence of other developmental disorders, and the absence of physical disorders such as epilepsy and visual, hearing, and motor impairments

(except ADHD). The exclusion criteria also included failure to complete the questionnaires or the questionnaires being distorted.¹⁴

Research instrument

Behavior Rating Inventory of Executive Function (BRIEF)

This inventory consisted of 86 questions that were used for children aged 6 to 12 years and were answered by the teacher, parent, or any person who knew the child well. To calculate the score of each subscale, the scores of the questions were summed, and the total score of the inventory was obtained from the sum of the scores of the research subcomponents; hence, the maximum score for the entire test was 172.¹⁴⁻¹⁶ A research used Cronbach's alpha to examine the internal consistency of the inventory, and the coefficients for inhibition were 0.85, displacement 0.77, emotion control 0.78, initiation 0.68, working memory 0.77, strategic planning 0.86, organization 0.77, and monitoring 0.77.¹⁷ Cronbach's alpha and test-retest reliability, and the Cronbach's alpha of the components were reported between 0.80 and 0.98; the test-retest reliability was reported with a correlation coefficient of 0.82.¹⁸ Cronbach's alpha coefficients for the components of the inventory were in the range of 0.78 to 0.99, which indicated a very high reliability of the inventory. In the present study, the reliability of the Behavior Rating Inventory of Executive Function (BRIEF) was calculated with a Cronbach's alpha coefficient of 0.81 for the total score, 0.78 for the behavioral ability index, and 0.83 for the metacognitive index.^{4,19}

The treatment sessions used in the present study are as follows

Cognitive rehabilitation program

The cognitive rehabilitation intervention was based on the implementation of the Captain Log cognitive rehabilitation program, designed in the United States, and it was implemented and used in the present study as a course of 20-45-minute sessions, three times a week (Supplementary file, Table S1).^{20,21}

Floortime Play Therapy

Floortime play therapy was implemented and used in the present study in a 20-session, 45-minute period, three times a week. During the sessions in the play space, factors such as continuous intimacy, appropriate emotional transfer for two-way verbal and non-verbal exchanges, emphasis on the child's attention and focus on the game and the passage of time during the game, prioritizing the child's desires and demands while considering the rules of the game, were considered, and the mother was asked to be present in the sessions (Supplementary file, Table S2).^{22,23}

Data analysis

For data analysis, repeated measures analysis of variance (ANOVA) and the Bonferroni post hoc test were performed using SPSS-22.

Results

The mean and standard deviation (SD) of age in the cognitive rehabilitation group were 9.13 and 1.19 years, in the Floortime play therapy group, 9.00 and 1.21 years, and in the control group, 8.80 and 0.86 years, respectively. Mean scores of the components and the total score of executive function deficits decreased in the two experimental groups. In contrast, similar changes were not observed in the control group at the aforementioned stages (Table 1).

Multivariate analysis showed the effect of implementing the independent variables on the components of inhibition ($P=0.001$), mental rotation ($P=0.002$), emotion control ($P=0.021$), initiation ($P=0.017$), and working memory ($P=0.001$). = F), strategic planning ($P=0.001$), organization ($P=0.002$), monitoring ($P=0.010$), and total score ($P=0.001$) of executive functions were significant (Table 2).

There was a significant relationship between the group effect, the time effect, and the interaction effect of group $\times$ time and inhibition (Group effect, time effect, interaction effect of group $\times$ time; each one, $P=0.001$), mental rotation (Group effect, time effect, interaction effect of group $\times$ time; each one, $P=0.001$), emotion control (Group effect, time effect, each one, $P=0.001$, interaction effect of group $\times$ time, $P=0.005$), initiation (Group effect,

time effect, each one, $P=0.001$, Interaction effect of group $\times$ time, $P=0.022$), working memory (Group effect, time effect, interaction effect of group $\times$ time; each one, $P=0.001$), strategic planning (Group effect, time effect, interaction effect of group $\times$ time; each one, $P=0.001$), organization (Group effect, time effect, interaction effect of group $\times$ time; each one, $P=0.001$), monitoring (Group effect, time effect, each one, $P=0.001$, interaction effect of group $\times$ time, $P=0.007$), total score (Group effect, time effect, interaction effect of group $\times$ time; each one, $P=0.001$) (Table 3).

There was also a significant relationship between the group differences, and inhibition (Cognitive rehabilitation-play group, $P=0.021$ and control group, $P=0.001$), mental rotation (Cognitive rehabilitation-play group, $P=0.046$ and control group, $P=0.001$, Floortime play therapy - Control group = 0.001), emotion control (Cognitive rehabilitation-play group, $P=0.031$ and control group, $P=0.001$), initiation (Cognitive rehabilitation- control group, $P=0.001$, Floortime play therapy - control group, $P=0.001$), working memory (Cognitive rehabilitation-play group, $P=0.030$ and control group, $P=0.001$, Floortime play therapy - Control group = 0.001), strategic planning (Cognitive rehabilitation-play group, $P=0.026$ and

Table 1. Mean $\pm$ SD of executive functions in the three stages of pre-test, post-test, and follow-up

Executive functions	Group	Pre-test	Post-test	Follow-up
Inhibition	Cognitive rehabilitation	18.33 $\pm$ 3.98	11.13 $\pm$ 2.42	11.87 $\pm$ 1.76
	Floortime play therapy	19.20 $\pm$ 3.68	13.93 $\pm$ 3.22	14.73 $\pm$ 2.84
	Control group	18.07 $\pm$ 3.70	18.47 $\pm$ 2.77	18.60 $\pm$ 2.82
Mental rotation	Cognitive rehabilitation	16.20 $\pm$ 3.34	10.18 $\pm$ 2.30	11.33 $\pm$ 2.76
	Floortime play therapy	16.67 $\pm$ 2.32	12.80 $\pm$ 2.01	12.07 $\pm$ 2.28
	Control group	16.70 $\pm$ 2.58	16.86 $\pm$ 2.33	16.73 $\pm$ 2.25
Emotional Control	Cognitive rehabilitation	14.60 $\pm$ 2.13	10.60 $\pm$ 2.03	9.20 $\pm$ 2.62
	Floortime play therapy	14.33 $\pm$ 2.47	12.20 $\pm$ 1.61	11.67 $\pm$ 2.23
	Control group	14.67 $\pm$ 2.23	14.33 $\pm$ 2.66	13.80 $\pm$ 2.46
Initiation	Cognitive rehabilitation	11.67 $\pm$ 2.30	7.93 $\pm$ 2.34	8.53 $\pm$ 1.81
	Floortime play therapy	12.00 $\pm$ 2.62	8.90 $\pm$ 2.16	8.86 $\pm$ 2.13
	Control group	11.93 $\pm$ 2.58	11.27 $\pm$ 2.28	12.00 $\pm$ 2.34
Working Memory	Cognitive rehabilitation	16.87 $\pm$ 2.17	11.67 $\pm$ 2.19	12.07 $\pm$ 2.18
	Floortime play therapy	17.13 $\pm$ 2.50	13.80 $\pm$ 2.37	13.53 $\pm$ 2.33
	Control group	16.60 $\pm$ 2.79	2.05 $\pm$ 17.07	16.73 $\pm$ 2.58
Strategic Planning	Cognitive rehabilitation	21.27 $\pm$ 3.37	12.93 $\pm$ 2.46	13.53 $\pm$ 2.38
	Floortime play therapy	20.80 $\pm$ 3.78	16.47 $\pm$ 3.38	16.80 $\pm$ 2.51
	Control group	20.53 $\pm$ 3.56	20.87 $\pm$ 3.09	20.40 $\pm$ 3.22
Organization	Cognitive rehabilitation	12.27 $\pm$ 2.19	8.87 $\pm$ 2.61	8.87 $\pm$ 1.95
	Floortime play therapy	12.33 $\pm$ 2.32	10.07 $\pm$ 2.19	10.13 $\pm$ 2.03
	Control group	12.25 $\pm$ 2.40	13.40 $\pm$ 2.10	12.67 $\pm$ 2.35
Monitoring	Cognitive rehabilitation	13.60 $\pm$ 2.26	9.38 $\pm$ 2.58	9.53 $\pm$ 2.61
	Floortime play therapy	13.80 $\pm$ 2.14	10.93 $\pm$ 2.52	11.47 $\pm$ 2.39
	Control group	13.27 $\pm$ 2.22	13.47 $\pm$ 2.50	13.60 $\pm$ 2.56
Total score	Cognitive rehabilitation	124.80 $\pm$ 8.76	82.53 $\pm$ 8.09	84.73 $\pm$ 5.79
	Floortime play therapy	126.27 $\pm$ 6.84	99.13 $\pm$ 6.17	99.27 $\pm$ 6.62
	Control group	124.00 $\pm$ 9.42	125.73 $\pm$ 7.06	124.53 $\pm$ 8.10

Table 2. Multivariate analysis of the effects of independent variables on the components and total score of executive functions

Dependent variable	Test power	η^2	P	df for error and hypothesis	F	Wilkes Lambda
Inhibition	0.986	0.237	0.001	4 and 82	6.36	0.582
Mental rotation	0.941	0.187	0.002	4 and 82	4.72	0.661
Emotional control	0.787	0.130	0.021	4 and 82	3.07	0.756
Initiation	0.806	0.135	0.017	4 and 82	3.20	0.748
Working memory	0.961	0.203	0.001	4 and 82	5.21	0.636
Strategic planning	0.994	0.261	0.001	4 and 82	7.25	0.546
Organization	0.937	0.185	0.002	4 and 82	4.65	0.664
Monitoring	0.853	0.149	0.010	4 and 82	3.59	0.724
Total score	1.00	0.565	0.001	4 and 82	26.64	0.189

Eta-squared $\times 100$; η^2 , Probability value; P, Degrees of freedom; df, F-statistics; F**Table 3.** Results of repeated measures analysis of variance in explaining the effect of independent variables on the components and total score of executive functions

Variable	Effects	η^2	P	F	SSE	SS
Inhibition	Group effect	0.462	0.001	18.06	554.27	476.55
	Time effect	0.489	0.001	40.19	282.60	270.37
	Interactive effect of group $\times$ time	0.307	0.001	9.30	649.07	287.36
Mental rotation	Group effect	0.636	0.001	36.67	236.53	412.99
	Time effect	0.415	0.001	29.82	311.12	220.90
	Interactive effect of group $\times$ time	0.229	0.001	6.23	624.20	185.27
Emotion control	Group effect	0.458	0.001	17.74	209.47	176.93
	Time effect	0.440	0.001	32.95	254.33	199.51
	Interactive effect of group $\times$ time	0.162	0.005	06.4	456.27	88.22
Initiation	Group effect	0.381	0.001	94.12	221.51	136.46
	Time effect	0.358	0.001	23.44	172.20	96.10
	Interactive effect of group $\times$ time	0.126	0.022	3.02	476.55	61.99
Working memory	Group effect	0.530	0.001	23.73	270.37	243.66
	Time effect	0.377	0.001	25.46	287.36	170.84
	Interactive effect of group $\times$ time	0.239	0.001	6.59	412.99	151.23
Strategic planning	Group effect	0.469	0.001	18.78	220.90	496.31
	Time effect	0.472	0.001	37.59	185.27	352.04
	Interactive effect of group $\times$ time	0.333	0.001	10.46	176.93	335.64
Organization	Group effect	0.428	0.001	15.70	199.51	197.53
	Time effect	0.248	0.001	13.87	88.22	72.90
	Interactive effect of group $\times$ time	0.217	0.001	5.81	136.46	102.74
Monitoring	Group effect	0.435	0.001	16.17	197.82	152.28
	Time effect	0.227	0.001	12.32	313.80	1.92
	Interactive effect of group $\times$ time	0.156	0.007	3.89	542.44	100.56
Total score	Group effect	0.854	0.001	122.61	2934.40	17132.93
	Time effect	0.751	0.001	79.73	5829.97	11066.71
	Interactive effect of group $\times$ time	0.691	0.001	46.96	4169.93	9321.82

Eta-squared $\times 100$; η^2 , Probability value; P, Degrees of freedom; df, F-statistics; F, Sum of Squares due to Error; SSE, Sum of Squares; SS

control group, $P=0.001$, Floortime play therapy - control group = 0.001), organization (Cognitive rehabilitation-control group, $P=0.001$, Floortime play therapy - control group = 0.001), monitoring (Cognitive rehabilitation-play group, $P=0.032$ and control group, $P=0.001$, Floortime play therapy - control group = 0.013), and total score (Cognitive rehabilitation-play group, $P=0.001$ and control group, $P=0.001$, Floortime play therapy - control

group = 0.001) (Table 4).

Discussion

This research aimed to compare cognitive rehabilitation and Floortime on executive functions in children with ADHD. The results of data analysis showed that the mean scores of deficits in executive functions and their components (inhibition, mental rotation, emotion control, initiation,

Table 4. Bonferroni post hoc test for pairwise comparisons of group effects on components and total score of executive functions

Variable	Times		P	SE	Mean difference
Group differences					
Inhibition	Floortime play therapy	Cognitive rehabilitation	0.021	0.76	2.18-
	Control group	Cognitive rehabilitation	0.001	0.76	-4.60
	Control group	Floortime play therapy	0.009	0.76	-2.42
Mental rotation	Floortime play therapy	Cognitive rehabilitation	0.046	0.50	-1.27
	Control group	Cognitive rehabilitation	0.001	0.50	-4.18
	Control group	Floortime play therapy	0.001	0.50	-2.91
Emotional control	Floortime play therapy	Cognitive rehabilitation	0.031	0.47	-1.27
	Control group	Cognitive rehabilitation	0.001	0.47	-2.80
	Control group	Floortime play therapy	0.007	0.47	-1.53
Initiation	Floortime play therapy	Cognitive rehabilitation	0.773	0.48	-0.56
	Control group	Cognitive rehabilitation	0.001	0.48	-2.36
	Control group	Floortime play therapy	0.001	0.48	-1.80
Working memory	Floortime play therapy	Cognitive rehabilitation	0.030	0.48	-1.29
	Control group	Cognitive rehabilitation	0.001	0.48	-3.28
	Control group	Floortime play therapy	0.001	0.48	1.98-
Strategic planning	Floortime play therapy	Cognitive rehabilitation	0.026	0.77	2.11-
	Control group	Cognitive rehabilitation	0.001	0.77	4.69-
	Control group	Floortime play therapy	0.001	0.77	2.58-
Organization	Floortime play therapy	Cognitive rehabilitation	0.214	0.53	0.98-
	Control group	Cognitive rehabilitation	0.001	0.53	2.91-
	Control group	Floortime play therapy	0.001	0.53	-1.93
Monitoring	Floortime play therapy	Cognitive rehabilitation	0.032	0.46	1.22-
	Control group	Cognitive rehabilitation	0.001	0.46	-2.60
	Control group	Floortime play therapy	0.013	0.46	1.38-
Total score	Floortime play therapy	Cognitive rehabilitation	0.001	1.76	1.87-
	Control group	Cognitive rehabilitation	0.001	1.76	-27.40
	Control group	Floortime play therapy	0.001	1.76	-16.25

Probability value; P, Standard error; SE

working memory, strategic planning, organization, and monitoring) decreased in the experimental group compared to the control group. Therefore, the results indicated that the cognitive rehabilitation program was effective on executive functions and their components, and the present finding was also stable during the two-month follow-up period.

The results of our study were consistent with the findings obtained from Nazerieh and Niknam in 2023. According to their research results, cognitive computer game training has a significant effect on the working memory of children with ADHD.¹¹ Jafari et al, during 2024, also reported that cognitive rehabilitation training, by repairing mental damage and changing habits and the environment, leads to an improvement in the level of impulsivity in children. Also, focusing on children's senses helps to retrieve and organize information received from different senses.²⁴ Robledo-Castro et al. in 2023 showed that computer-based training sessions have positive effects on executive functions of working memory, attention, and inhibitory control in children with ADHD. However, the number of training sessions may not have a significant effect.

Overall, the evidence, the high variability of measurement instruments, and the high risk of bias between studies may also indicate differences in success rates. In contrast to our study, the evidence for the overall benefits of computer-based training on executive functions in children with ADHD did not show a significant effect on children in their study.⁷ Therefore, the Captain Log cognitive rehabilitation software, which focuses on brain functions and teaches navigation skills, response inhibition, multi-step instructions, and auditory and visual memory, can improve executive functions in these children. Performing the tasks and skills available in the Captain Log rehabilitation software requires the involvement of various parts of the brain, such as auditory and visual working memory. By performing targeted activities and moving to higher stages, the level of this involvement increases. With practice and repetition, it strengthens the active memory, increases concentration, and reduces the subject's behavioral tension. It can even be pointed out that the tasks of this intervention are based on reinforcement for the child's desire to stay in the treatment process.²⁵ On the other hand, an active brain forms very important neurological connections for

learning, while an inactive brain does not create these stable and necessary neurological connections. This is because the cognitive tasks in the Captain Log software, due to the ability to adjust the difficulty level of the tasks from simple to difficult, increase the activity and new connections of the brain over time.¹⁷ The results of data analysis showed that the average scores of executive function deficits and their components in the experimental group decreased compared to the control group. Therefore, the results indicated that Floortime play therapy was effective on executive functions and their components, and the present finding was also stable during the two-month follow-up period. Wong et al, in 2023, showed that ADHD groups receiving child-centered play therapy showed significant improvements in cognitive flexibility. Play therapy is a method that is a natural means of expressing a child's state, and therefore, play therapy helps the child express and control their emotional pressures. Games and toys are, in fact, children's words and, if carefully selected, can provide children with an opportunity to express their feelings and problems as they have experienced them.²⁶ The results of data analysis showed that the difference in the effect of the two cognitive rehabilitation methods and Floortime play therapy on executive function deficits and their components is significant. So, cognitive rehabilitation has reduced the average of those components and the total score of executive functions more than Floortime play therapy, and the present finding was also stable during the two-month follow-up period. Lack of cooperation from parents and children was one of the limitations of this study. It would also be better to study a larger sample size across a wider area. Other limitations included a lack of blinding, reliance on maternal reporting (reporting bias), and a lack of control for medication use (many ADHD children take medication).

Conclusion

There was a significant relationship between Floortime play therapy and the comparison of cognitive rehabilitation with Floortime on executive functions in children with inhibition, mental rotation, emotion control, initiation, working memory, strategic planning, organization, monitoring, and total score in ADHD.

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Authors' Contribution

Conceptualization: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh
Data curation: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh
Formal analysis: Parvin Ehteshamzadeh
Funding acquisition: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh
Investigation: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh
Methodology: Zahra Daste Bozorgi
Project administration: Sahar Safarzadeh
Resources: Sahar Safarzadeh
Software: Zahra Daste Bozorgi
Supervision: Sahar Safarzadeh
Validation: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh

Visualization: Parvin Ehteshamzadeh

Writing—original draft: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh
Writing—review & editing: Zohreh Ghasemi Mehrabadi, Sahar Safarzadeh, Parvin Ehteshamzadeh, Zahra Daste Bozorgi

Competing Interests

The authors have no conflicts of interest.

Ethical Approval

This research was performed according to the Ethics code; IR.IAU.AHVAZ.REC.1403.127.

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Supplementary File

Supplementary file contains Tables S1 and S2.

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