

The Effectiveness of Convergence, Adaptive Ease, and Saccade Movements on the Reading Ability of Primary School Students with Dyslexia: A Randomized Clinical Trial

Hanieh Falahatipour¹, Amanollah Soltani², Mitra Kamiabi², Hamdollah Manzari-Tavakoli²

Original Article

Abstract

Introduction: The ability to read and understand is one of the most vital skills in the modern world today. Due to the fact that many people have reading problems, the need for early and correct diagnosis and effective treatment is felt. The aim of the present study was to determine the effectiveness of convergence, adaptive ease, and saccade movements on reading ability in primary school students with dyslexia in Rafsanjan, Iran.

Materials and Methods: This study was a randomized clinical trial in which 45 subjects were selected from all second grade students with dyslexia in Rafsanjan in the academic year 2019-2020 by purposive sampling method and randomly divided into experimental and control groups. The intervention was performed in 15 sessions of 30 minutes. The control group, with the agreement of the child and the parents, did not receive any parallel treatment process during the study. In the experimental and control groups, the Analysis of Persian Reading Ability (APRA) test was used. Multivariate analysis of covariance (MANCOVA) was used to analyze the data.

Results: Convergence, adaptive ease, and saccade movements had a significant effect on improving reading ability in children with dyslexia ($P < 0.010$).

Conclusion: Convergence, adaptive ease, and saccade movements may effectively improve reading accuracy and comprehension ability in children with dyslexia.

Keywords: Dyslexia; School children; Convergence effectiveness; Saccade movements; Adaptive ease

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Introduction

Dyslexia, a subcategory of specific learning disorders, is a condition in which people struggle with reading words correctly, and read slowly or with difficulty. They may also have difficulty accurately understanding the meaning of what they read and spelling words (1). Reading is a complex cognitive process that requires visual cues, attention to phonetic cues, and systematic decoding based on phonology (2). To be able to read, one has to possess basic skills such as language development, movement, visual and listening skills, the ability to distinguish between visual and auditory skills, and, the ability to pay attention and concentrate (3).

Recent reports indicate that dyslexia affects approximately 10% of primary school students in Iran, with boys being twice as likely to be affected as girls (3). Despite having high levels of natural intelligence, dyslexic children typically struggle with academic progress (4) and may experience difficulty or drop out of school. Thus, this disorder can have adverse social, economic, cultural, and emotional-psychological consequences for individuals and society (5).

It is common for students who struggle with reading to have difficulty comprehending the material, which can impact their performance in other academic subjects (5). Reading problems are now recognized as one of children's most prevalent signs

1- PhD Student in Educational Psychology, Department of Psychology, School of Humanities, Kerman Branch, Islamic Azad University Kerman, Iran

2- Assistant Professor, Department of Psychology, School of Humanities, Kerman Branch, Islamic Azad University, Kerman, Iran

Corresponding Author: Amanollah Soltani, Email: amanallahsoltani@iauk.ac.ir

of learning disorders. They are typically associated with difficulties in the brain's ability to process and acknowledge information (6).

It requires the coordination of different senses and their simultaneous activity (2). The ability to read is crucial to students' academic progress (5). Dyslexia is a learning disorder that affects reading ability. Researchers have identified various causes of dyslexia. Some have pointed to phonological disorders and believe phonological awareness in people with dyslexia is lower than in typical children (3-8). Another group of researchers has emphasized cerebellar disorders, which can lead to cognitive disorders such as imbalance, motor skills, phonological skills, and rapid information processing (3, 9, 10). However, despite evidence showing differences in the cerebellum's cognitive, anatomical, and metabolic functions in people with dyslexia, a consistent connection between the cerebellum and language has not been established (8). Some researchers believe that the primary cause of dyslexia is failure in visual functions, but this theory is still debated (4, 8, 9, 11-20). Reduced attention and concentration, visual perception, and spatial communication are critical to dyslexia. Children with this disorder often have problems in communication between their body parts, and others problems such as coordination between eyes and hands, spatial orientation, and recognition of right and left, up and down, and sequence of letters and words (21).

The idea that visual perception defects might cause dyslexia was one of the earliest hypotheses. According to this hypothesis, visual perception plays a crucial role in reading because it is responsible for processing a significant portion of information (5-21). Children with dyslexia often struggle with processing visual information, which strongly correlates with reading comprehension (4). To read correctly, the visual system responsible for receiving visual information must be accurate, and the visual information processing must also be performed correctly. This section involves a series of visual-cognitive skills that enable individuals to organize and classify, interpret visual stimuli, and make sense of what they see (10, 18, 20). The most important cognitive feature for dyslexic individuals, which significantly impacts their reading and writing abilities, is visual processing and short-term memory. Neurologically, dyslexic individuals have a distinct pattern of cognitive abilities (20).

Reading requires several visual functions such as penetration, accommodation, saccade movements, convergence, and coordination of eye movements

(10-19). Research has shown that impaired acuity can significantly affect the ability to read (22, 20).

A child who struggles in reading and understanding texts has a limited chance of success in school. Failing to learn to read early can also hinder children's progress in other subjects (2). These children may negatively perceive their abilities, leading to reduced academic motivation and increased procrastination, anxiety, and stress (6). In the elementary years, reading is crucial for comprehending the contents of various subjects such as science, mathematics, and Persian. It plays a vital role in the academic progress of children (5). Many researchers have paid close attention to this issue at the elementary level (3-7). Failure in class activities often leads to doubts about success, which, in turn, causes students to lose interest in lessons and education, to the extent that many of them drop out of school and prefer challenging and exhausting and even fake jobs to continuing their studies (6). Some receive inappropriate labels due to continuous failures in education, weakness in dictation, arithmetic, or reading, and ignorance of teachers and school officials, despite having average intelligence and appropriate physical and mental ability, others may be forced to drop out of school due to mental retardation, and emotional and or behavior disorders (4).

To treat the problems related to reading disorder, different approaches have been suggested, including the corrective reading program (6), the multi-sensory approach (4), the Fernald method (3), and the perceptual enrichment approach (6), accommodation (8), saccadic eye movement (9), convergence and vergence or eye coordination (10). Students with math disorders and dyslexia showed poor visual-spatial perception and working memory performance compared to regular students (11). Recent research on visual perception stimuli, adaptive ease, and saccade movements (8-10) has brought about satisfactory results in dyslexic students (9, 8, 6, 4). Some exercises improve hand-eye coordination, body awareness, and movement planning, and enhance skills related to visual senses (9).

For example, the significant effect of these exercises on visual perception and visual minds strengthening in students has been confirmed (9-12). Thus, the use of correction and rehabilitation programs for these children, and the initial correct assessment of the failures of various components in processing children's visual function can help shorten the treatment programs (5).

Since the prevalence of dyslexia is higher in primary school students (3), and in educational planning in Iran, students' reading and comprehension skills are completed in the second and third grades in all schools (7). Implementing treatments to improve dyslexia in elementary school is prioritized (5). Due to the limited research background in the field of using convergence and adaptive ease and saccade movements to improve reading accuracy, the present study investigated the effectiveness of convergence and adaptive ease exercises on reading accuracy, and reading comprehension of dyslexic students in Rafsanjan, Iran. The focus of the current research was on visual abilities and skills. Since convergence, adaptive ease, and saccade movement exercises, in addition to visual skills, will increase capacities and capabilities in perceptual, sensory, and motor fields, the possibility of experiencing success in academic and non-academic life seems more likely for the student.

Materials and Methods

This research was a randomized clinical trial, and in it, convergence, adaptive ease, and saccade movements were considered as independent variables, and reading accuracy and reading comprehension of dyslexic children were considered as dependent variables. Convergence, adaptive ease, and saccade movements interventions were implemented as a cluster in the intervention group.

The study population included all students with reading disorders in Rafsanjan. Due to time constraints, financial facilities, and the specific group of children studied (children with reading disorders), the statistical population was selected using the available sampling method. Information about the kind of treatment, how they would attend the meetings, and the number and duration of meetings was given to the students and their parents. Confidentiality was explained as the fundamental principle in the treatment, and finally, the clients who completed the initial consent form of the questionnaire form were selected. The ethics code IR.IAU.KERMAN.REC.1400.005 was received for the research from the Research Vice-Chancellor of Islamic Azad University, Kerman Branch, Iran. The inclusion criteria of the study include the diagnosis of dyslexia by clinical psychologists according to the DSM-5 (1), studying in the second to fifth grade of elementary school, not having any other physical disorders or diseases that aggravate dyslexia [based on the opinion of clinical child psychologists and child psychiatrists. (12)], not undergoing a parallel treatment process, the parents' consent for the student

to participate in the research and the student's consent to participate. Absence from more than 2 sessions, not doing homework, and not completing the pretest and posttest questionnaires were considered as the exclusion criteria.

, the statistical population of 45 primary school students with dyslexia in Rafsanjan was considered as the study sample. Upon visiting an ophthalmologist, it was discovered that all of these students had vision problems. Therefore, the researcher divided them into control and intervention groups using a simple random method based on the evaluation session of the child with the adolescent clinical psychologist, and according to the diagnosis of the ophthalmologist. The first group was characterized by adaptive ease/convergence, while the second group had saccade movements. The participants were numbered from 1 to 45 and were further divided into 3 groups. The first intervention group consisted of participants numbered from 1 to 15, while the second intervention group was made up of participants numbered from 16 to 30. The remaining participants, numbered from 31 to 45, were included in the control group. It is important to note that three participants were excluded from the research due to non-continuation of treatment and non-cooperation. In total, 42 participants completed the study, with 14 participants in each group.

In this study, the examiner and the therapist were specialized doctorates in educational and clinical psychology for children and adolescents. However, they were not blinded to the investigated groups. The intervention group received convergence exercises and adaptive ease and saccade movements due to the importance of these exercises (8-10). The same therapist conducted the interventions for all 3 groups. The treatment sessions were 15 group sessions (30 minutes each) twice a week for each group of 15 participants. The control group did not receive any parallel treatment process during the research. Still, they agreed to accept the convergence exercises, adaptive ease, and saccade movements after the completion of the study. A doctorate in educational psychology conducted the data analysis.

Adaptive ease can cause the eyes to move closer together when looking at objects up close, such as when reading or working on a computer (8). Specific exercises can help improve adaptive ease (10). For instance, a Snellen chart can be placed 40 cm away from the child's eyes (8). The child works with the examiner to choose a target sign located 2 lines above their best vision. The examiner then places a lens with a power of (+2) in front of the child's eyes, which

makes their vision slightly blurry. The child is asked to try and see the chosen sign clearly, and once they do, the examiner replaces the lens with a (-2) lens. The process is repeated with 4 lenses with powers of (-2) and (+2) (two for each eye) to practice matching binoculars (10). The first intervention group did adaptation and convergence training using flipper lenses for 10 minutes, with a 1-minute rest for every minute of training. The child was asked to clearly see the image of the sign they were staring at. The number of apparent sightings per minute was recorded. For convergence training, the child was asked to look at a distance of 40 cm using a prism and a myopic chart. The child reported blurred vision and double vision by moving the prism in front of their eyes. The number of blurs and diplopia were recorded during the test.

Saccades are high-speed movements that cause the rapid movement of the eyeball (9). To perform this exercise, the alternating visual focus method or Optosys software (Optosys Solution, Montreal, Canada) is used. A ruler with two marks attached to it was placed in front of the children's eyes at different distances from the face, and they were asked to move their gaze from 1 mark to another without moving their head and at the highest possible speed. The examiner recorded the number of cycles (back and forth movement of the eye) in 1 minute. In the Optosys software, a target moves in front of the children's eyes and they have to follow it and point to it on the monitor screen (9). In the second group, saccade movements were practiced using Optosys software. For each 1-minute effort, a 1-minute break was given to the child, and the number of times the child succeeded was recorded.

The Analysis of Persian Reading Ability (APRA) scale was used to check reading accuracy and reading comprehension. This questionnaire has been prepared to evaluate the reading ability of elementary school Fars students and includes the 4 subscales of recognizing the names and sounds of the letters of the alphabet, reciting words, reciting sentences, and understanding sentences (13). According to the test instructions, the reading accuracy and comprehension scores are calculated by counting the number of words that the student reads correctly and understands in the reading section of the reading ability test. Reading mistakes include replacing words, inverting, and deleting, adding, moving and analyzing, and mispronouncing words. Correctness of reading and understanding of the instructions are the same, but have separate scores. Based on the statistical analysis, the test of reading texts has high reliability and validity. Convergent validity in each of the two parts

of the test has been obtained by calculating the correlation coefficient of the Persian reading scores with total reading accuracy scores on even and odd cards (0.50), which is significant at $P < 0.001$ (14).

A study was conducted in Tehran, Iran, to investigate the psychometric properties of the APRA test, which included a sample of 411 primary school students, both normal and dyslexic, of different educational levels. The test's reliability was calculated using Cronbach's alpha coefficient, which was 0.94, 0.96, 0.91, and 0.91 for letters, words, texts, and phonological awareness, respectively. The content validity of the scale was examined and corrected, and its criterion validity was assessed by correlating the test scores with students' class reading average, which ranged from 0.20 to 0.6. The study also investigated the relationship between grades and age changes as construct validity. The results indicated that all subscales, except for letter sounds, had a significant positive relationship with age (range from 0.20 to 0.60). The independent t-test results showed a significant difference between the scores of dyslexic and regular students in the texts subscale of the APRA test. The study also found appropriate internal consistency for different subscales (13). MANCOVA was used to test the hypothesis after determining the descriptive statistics, skewness, and kurtosis. Finally, the data were analyzed using SPSS software (version 21; IBM Corp., Armonk, NY, USA).

Results

The degree of skewness and kurtosis for all variables was between -2 and 2, which showed that the distribution of all the investigated data followed normal distribution. Levene's test was used to determine the homogeneity of variances. The demographic characteristics of the study participants are presented separately in table 1.

In both test groups, there was a higher percentage of boys in the third grade of elementary school; however, it is important to note that gender did not affect the indicators investigated in this study. None of the participants were in the first grade of elementary school. Before conducting MANCOVA, the assumptions related to this test were examined. The results of Levene's test for saccade movements ($F = (14.2) 1.43$; $P = 0.001$) and convergence/adaptive ease ($F = (14.2) 3.169$; $P = 0.001$) confirmed the assumption of homogeneity of variances. In the skewness and kurtosis test, it was confirmed that the data followed a normal distribution. Table 2 presents the average scores of saccade movements and convergence/adaptive ease in reading ability for the experimental and control groups.

Table 1. Average refractive errors in the right and left eyes

Group	N	Girls	Boys	Grade of elementary school					Age (years) (mean \pm SD)	F	df	P
				1	2	3	4	5				
Saccade movement	14	6	8	0	3	6	3	2	9.28 \pm 0.99	1.87	2 (39)	0.167
Convergence/ Adaptive ease	14	3	11	0	1	5	5	3	9.71 \pm 0.91			
Control	14	7	7	0	5	6	1	2	9.00 \pm 1.03			
P-value (different between groups)	< 0.001	0.470	0.900	0.001	0.122	0.003	0.003	0.200	0.001			

df: Degree of freedom; SD: Standard deviation
Significance at $P > 0.05$ level

The results of MANCOVA are presented in table 3.

Based on the data presented in table 3, the mean posttest scores of the reading accuracy and reading comprehension subscales increased in the convergence/adaptive ease and saccade movements groups, and the control group compared to the pretest. The effect size of saccade movements, convergence, and adaptive ease was, respectively, 0.62 (high effect size), 0.27 (medium effect size), and 0.7 (high effect size), which shows the strength of the intervention effect. Nevertheless, it can be concluded that the adaptation ease exercises were more effective than the other two. The effectiveness of teaching saccade movements and convergence/adaptation ease in the posttest stage on the reading ability of students with dyslexia is shown in table 4.

The data presented in table 4 shows that in the experimental group, there was an improvement in saccade movements and convergence/facility of adaptation, resulting in better adjusted average scores of reading accuracy ($F = (14.2) (182.182)$; $P = 0.001$) and reading comprehension ($(14.2 = 36.822)$ ($F, P = 0.001$)) compared to the control group. The results in both test groups were the same regarding reading accuracy and comprehension. The effect size was significant, with a value greater than 0.5 in all cases, indicating a substantial effect size. This means that teaching saccade movements and convergence/facility of adaptation had a high impact on reading accuracy and comprehension. The Bonferroni post hoc test determined the significant

differences between the groups regarding the dependent variables. The results revealed that the reading accuracy of the convergence/ease group (corrected mean = 96.835) was significantly different from the saccade group (corrected mean = 94.899) ($P = 0.010$). The control group differed significantly from the study groups in terms of this variable ($P < 0.001$).

The study found a significant difference between the saccade group (corrected mean = 94.899) and the control group (corrected mean = 88.766) ($P < 0.001$). The saccade group also showed a significant difference in reading comprehension compared to the control group (corrected mean = 57.947 vs. 49.818, $P < 0.001$). The convergence/facility group (corrected mean = 55.878) also showed a significant difference compared to the control group ($P = 0.001$). However, there was no significant difference between the saccade and convergence/facility groups ($P < 0.050$). The study also revealed that convergence and adaptive ease training and practice were most effective in increasing reading accuracy in children with reading disorders in elementary school. This is supported by the high average reading accuracy observed in the convergence/accommodative ease group compared to the saccade and control groups.

Based on the data presented in table 5, mean and standard deviation indicators were used to describe the studied variables (reading accuracy and reading comprehension) in the pretest and posttest in both experimental and control groups.

Table 2. The value of the investigated variables in the experimental and control groups before and after the study

Group	Accuracy of reading		P (difference within groups)	Comprehension		P (difference within groups)
	Pretest	Posttest		Pretest	Posttest	
Convergence/ Adaptive ease	85.93 \pm 3.20	97.21 \pm 1.31	0.670	45.43 \pm 2.24	56.00 \pm 2.29	0.530
Saccade movement	86.36 \pm 4.65	95.79 \pm 2.33	0.330	46.64 \pm 1.98	58.64 \pm 3.01	0.460
Control	83.28 \pm 4.89	87.50 \pm 4.36	0.016	44.64 \pm 2.34	49.00 \pm 2.80	0.410
P-value (different between groups)	0.002	0.009		0.004	0.008	

SD: Standard deviation

Table 3. Analysis of covariance results of the performance of the children with reading disorder in saccade movements, convergence, and ease of eye adaptation

Independent variable	Dependent variable	Sum of squares	df	F-statistics	P-value	Effect size	Power
Group	Saccade (number of movements)	972.453	2 (34)	28.796	0.001	0.629	1.00
	Convergence (duration of blurring or doubling of the image until it becomes clear)	48.126	2 (34)	6.436	0.004	0.275	0.88
	Right eye adaptive ease (number of times to clearly see the image)	47.671	2 (34)	48.656	0.001	0.741	1.00
	Left eye adaptive ease (number of times to clearly see the image)	39.690	2 (34)	44.045	0.001	0.722	1.00
	Both eyes adaptive ease (number of times to see the image clearly)	25.976	2 (34)	45.307	0.001	0.727	1.00

df: Degree of freedom

This showed that the posttest mean of the subscales of reading accuracy and reading comprehension in all 3 study groups were increased compared to the pretest.

Discussion

This research was conducted to investigate how convergence, adaptive ease, and saccade movements affect the reading ability of dyslexic students in Rafsanjan. The results showed that controlling visual disorders related to dyslexia through this method could increase reading ability, including accuracy and comprehension, compared to the control group. This was consistent with the findings of the study by Grisham et al. (15). Another study found a significant relationship between saccade control and reading disorder in dyslexic children compared to the control group (16). Other studies on convergence insufficiency also support these results (10, 17). The present study found that appropriate exercises could improve these disorders, leading to improved accuracy and comprehension of the material by children in the experimental groups. This improvement can positively impact classroom activities and lead to academic success (5). The exercises can also increase reading ability, thus positively affecting education by improving and lengthening students' study hours.

The findings of Sharif et al. indicate that convergence weakness can interfere with studying

and working on computers (8). This theory is consistent with the findings of the present study. However, they did not investigate the impact of these exercises on working with a computer.

Reading problems are often associated with visual impairments. Although visual impairment may not be the primary cause of dyslexia, it can lead to reading difficulties. Numerous studies conducted on children with reading problems have reported a significant relationship between the insufficiency of adaptive ease and eye movements (such as an increase in the number of forward fixations along a line of text, longer fixations, and a rise in the number of repetitions) compared to ordinary people (12, 10, 8). Additionally, a significant relationship exists between saccade movement control and reading disorder (9). After performing visual interventions, visual functions have been shown to improve, and as a result, strengthened reading performance in students (20, 18, 15, 4).

Several research studies have shown that attention to vision interventions can increase the rate of improvement in students' reading ability (22, 2). It appears that practice and experience can lead to quicker saccade movements (19). Possibly, visual intervention can enhance reading performance by addressing visual inadequacies related to reading (6). Additionally, it has been observed that improving the function of the visual system of people with dyslexia who had problems in visual processing resulted in an improvement in their reading performance (20).

Table 4. Multivariate analysis of covariance results for the effectiveness of teaching saccade movements and convergence/adaptation ease in the posttest stage on the reading ability of students with dyslexia

Independent variable	Dependent variable	Sum of squares	df	F-statistics	P	Effect size	Power
Group	Reading accuracy (number of words read correctly)	439.833	2(37)	86.182	0.001	0.823	1.00
	Reading comprehension (the number of words read and the meaning understood)	414.477	2 (37)	36.822	0.001	0.666	1.00

df: Degree of freedom

Table 5. Mean of pre-test and post-test of studied variables in the experimental and control groups

Variables	Convergence/adaptive ease (14 people) (mean ± SD)		Saccade movements (14 people) (mean ± SD)		Control (14 people) (mean ± SD)	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Reading accuracy	85.93 ± 3.20	97.21 ± 1.31	86.36 ± 4.65	95.79 ± 2.33	83.28 ± 4.89	87.50 ± 4.36
Reading comprehension	45.43 ± 2.24	56.00 ± 2.29	46.64 ± 1.98	58.64 ± 3.01	44.64 ± 2.34	49.00 ± 2.80

SD: Standard deviation

Moreover, these exercises can improve hand-eye coordination, body awareness, and movement planning. They also strengthen the skills related to visual senses (9), significantly affecting visual perception and enhancing visual senses in students (21). Furthermore, these exercises can improve students' visual-spatial perception and working memory (22).

Previous studies have shown that parenting styles involving playing games to strengthen visual functions can enhance convergence and saccade movements, and thus, improve the reading performance of children with specific learning disabilities such as dyslexia (7). As a result, rehabilitation programs that focus on improving essential visual functions can help children with dyslexia improve their reading ability (18). The positive results of the present study were also due to the promotion of visual functions, which significantly impacted children's reading skills. This is especially important in the early years of education, where reading correctly is crucial for understanding various subjects, including science, mathematics, and language. Strengthening the compatibility and ease of convergence of the 2 eyes through various vision interventions can improve the reading performance of students with dyslexia, thus preventing a decline in their academic performance (22). These findings are consistent with the results of the present research.

The current study demonstrates that a rehabilitation program focused on improving visual perception and movement skills can significantly enhance reading accuracy and comprehension scores, while reducing reading error rates. Specifically, saccade exercises utilizing the method of intermittent change of visual focus can strengthen and correct eyeball movements, leading to more accurate word recognition and improved reading comprehension (9). Additionally, convergence exercises and changing lenses to adjust visual clarity can enhance the eyes' ability to come closer and focus more closely, resulting in an increased number of correctly read words and a better understanding of the reading material (8).

The present study found a significant difference in reading accuracy between the convergence/

accommodation ease and saccade groups compared to the control group. Additionally, there was a significant difference between the convergence/adaptive ease and saccade groups. In reading comprehension, the convergence/adaptive ease and saccade groups significantly differed from the control group, but not from each other. It can be concluded that the training and practice of saccade movements, convergence, and ease of matching positively impact the reading accuracy and comprehension of children with reading disorders in elementary school. The intervention had a significant effect size of 0.82 for reading accuracy and a medium effect size of 0.66 for reading comprehension, indicating the strength of the intervention effect.

Due to the lack of similar research, it was impossible to compare the results and the effectiveness of this treatment on students' reading accuracy and comprehension. Students with reading disorders have difficulty learning the course material and answering exam questions due to mistakes and quick reading without understanding the material. The present study results suggest that saccade movements, convergence, and adaptive ease exercises can improve the reading accuracy and comprehension of dyslexic students.

Limitations

Due to financial constraints and limited research time, extended follow-up was not possible.

Recommendations

Longitudinal studies should be conducted to investigate the long-term effects of the intervention. Similar studies should be conducted in primary schools.

Conclusion

The results show that convergence exercises, adaptive ease, and saccade movements significantly impact the reading ability of students with dyslexia. Therefore, it is recommended that these exercises be incorporated into the treatment programs for elementary school students with dyslexia. Doing so can be highly beneficial to their reading skills.

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Authors' Contribution

Study design and ideation: Hanieh Falahatipour,
Obtaining financial resources for the study: Hanieh Falahatipour
Scientific and executive support of the study: Hanieh Falahatipour, Amanollah Soltani, Mitra Kamiabi, and Hamdollah Manzari Tavakoli
Data collection: Hanieh Falahatipour
Analysis and interpretation of the results: Hanieh Falahatipour, Amanollah Soltani, Mitra Kamiabi, and Hamdollah Manzari Tavakoli
Specialized statistics services: Hanieh Falahatipour and Amanollah Soltani
Manuscript preparation: Hanieh Falahatipour, Amanollah Soltani, Mitra Kamiabi, and Hamdollah Manzari Tavakoli
Specialized scientific evaluation of the manuscript: Hanieh Falahatipour, Amanollah Soltani, Mitra Kamiabi, and Hamdollah Manzari Tavakoli
Confirmation of the final manuscript for submission to the journal website: Hanieh Falahatipour, Amanollah Soltani, Mitra Kamiabi, and Hamdollah Manzari Tavakoli

Maintaining the integrity of the study process from the beginning until publication, and responding to the referees' comments: Hanieh Falahatipour, Amanollah Soltani, Mitra Kamiabi, and Hamdollah Manzari Tavakoli

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Conflict of Interest

The authors do not have any conflicts of interest. Hanieh Falahatipour attracted the funding for the basic study related to this article and has been a student at Islamic Azad University, Kerman Branch since 2016. Dr. Amanollah Soltani, the first supervisor, has been an assistant professor at Islamic Azad University, Kerman Branch since 2001. Dr. Mitra Kamiabi, the second supervisor, has been an assistant professor at Islamic Azad University, Kerman Branch since 2012, and Dr. Hamdollah Manzari Tavakoli has been an assistant professor at Islamic Azad University, Kerman Branch since 2004.

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