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Research Paper

Effectiveness of mindfulness-based training on response inhibition and selective attention in students with Specific Learning Disorder

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Abstract

Aim: The aim of the current study was to examine the effectiveness of mindfulness training on response inhibition and selective attention in students with Specific Learning Disorder (SLD). This quasi-experimental controlled study was conducted with a pretest-posttest design. The research population consisted of all the 30 students referred to the Center of Learning Disabilities in Ajabshir, who were recruited by census sampling. They were then randomly divided into experimental (15 students) and control (15 students) groups. The Stroop effect test was used to measure response inhibition, and the Toulouse-Piéron Cancelation Test (TP) was administered to assess selective attention. The intervention was given based on a workbook by Jon Kabat Zinn and Debra E. Burdick. The experimental group participated in eight group mindfulness therapy sessions and the control group did not get any treatments. Date were analyzed using a Multivariate Analysis of Covariance, which showed significant differences in selective attention between the experimental and control groups after mindfulness training. Nevertheless, no significant difference was observed between the two groups in response inhibition. In general, mindfulness training can be considered an effective intervention to improve selective attention for students with learning disabilities.

***Keywords**: Mindfulness Training, Response Inhibition, Selective Attention, Students with Specific Learning Disorder*

Introduction

Specific Learning Disorder (SLD) is a neurodevelopmental disorder with three main specifiers (reading, writing, and mathematics) (DSM-5, 2013). According to research, students with SLD have dysfunctions in some special cognitive processes (Vanbenen et al., 2015; Nick, Nicolas, 2015; Taghizadeh et al., 2018). Based on previous studies, response inhibition (controlling and managing unrelated information) is one of the main underlying reasons for the development of SLD (Taghizadeh et al., 2017). Forstman et al. (2008) argued that the right hemisphere cortex is directly related to response inhibition. In addition, selective attention (focusing on one stimulus and ignoring the other stimuli) is another major ability required for academic achievement (Garsia et al., 2007; Amani et al., 2017).

Mindfulness is defined as being aware of the present moment and living it without judging the situation (Crein, 2009). Previous studies have used mindfulness as an intervention for various issues. For example, Shakib et al. (2016) used mindfulness-based training to improve the response inhibition and other cognitive functions of students with ADHD. In a similar study, Rezaei and Sardari (2020) found that mindfulness training can be used as an appropriate treatment strategy for improving response inhibition in children with ADHD.

The main question sought to be answered in the present study is whether mindfulness-based training improves response inhibition and selective attention in students with SLD.

Methodology

The present quasi-experimental study was conducted using a pretest-posttest design with a control group. The statistical population included elementary school students with learning disabilities referred to the Center of Learning Disabilities in Ajabshir, East Azerbaijan Province, Iran. Thirty students were selected by census sampling and divided into experimental and control groups by simple random assignment. Fifteen of them were assigned to the control group and 15 to the experimental group. The experimental group received mindfulness training for two months (eight sessions, each approximately 60 minutes). Finally, the following tools were used to collect data for the research:

Stroop Color and Word Test (SCWT): This test is suitable for measuring response inhibition (Coppola, 2010; Narimani et al., 2012). This study used the Victoria version (Spreen and Strauss, 1998) in three steps. In the first step, the students are asked to name the colors (red, blue, yellow and green) printed in black ink as fast as they can. In the second step, the student must read the name of colors printed in an ink of the same color. In the third step,

the subject should read the name of colors printed in a mismatching ink color (e.g., the word 'yellow' is printed in green ink). Ghadiri et al. reported the test-retest reliability of SCWT as 0.6 for the congruous words step and 0.97 for the inconsistent words step (Rahmani et al., 2019). Ekhtiari et al. (2008) also reported the test-retest validity of this test as 0.89 (Ghasemi et al., 2012).

Toulouse-Piéron Test (Comet Squares Test): This scale was used to measure selective attention. The test consists of 80 cubes drawn on an A4 sheet, requiring the subject to draw the same cubes as the pattern given at the top of the page. The scoring method is such that 1 positive point is given for each correct answer and 0.5 negative points are given for each wrong or missing answer, and their algebraic sum shows the score of the students. According to studies carried out in Iran, the reliability of this test with Cronbach's alpha method is 0.75 (Afrooz et al., 2014) and the concurrent validity of the test with Bourdon Test has been reported as 0.74 (Irvani, 2001; Narimani et al., 2012).

Results

In this study, the posttest scores of the dependent variables were analyzed using a multivariate analysis of covariance and related data. The assumptions of the analysis of covariance were investigated using the Kolmogorov-Smirnov test, which showed normal distribution for the selective attention ($Z = 0.15$; $P = 0.07$) and response inhibition ($Z = 0.09$; $P = 0.2$) variables. Levene's test was also used to examine the equality of variances in the posttest variables' error between the experimental and control groups. According to this test, the F-value calculated for each variable was non-significant, meaning that this assumption was also met.

The analysis of variance for interaction effects also showed that the assumption of homogeneity of the interaction effects has been met, because the F-values related to the interaction effects (0.55) were not significant at the level of $P<0.05$. Finally, the assumption of normal correlation between the dependent variables was also met, because Bartlett's sphericity test indicated that the combined correlation between the dependent variables is desirable. Given that the assumptions were met for using MANCOVA, the differences between the experimental and control groups were investigated by this method, as discussed in the following.

The calculated F (4.64) was significant at $P<0.05$, demonstrating a significant difference between the control and experimental groups in at least one of the dependent variables.

Table 1. The ANCOVA examining the effects of mindfulness training on each of the dependent variables after adjusting for the pretest values

Variable	Source	Total squares	Df	Average squares	F	Significance level	Eta coefficient	power
Response inhibition	Methode	7/851	1	7/851	0/53	0/47	0/02	0/1
	Error	3841/517	26	14/789				
	All	3340	30					
Selective attention	Methode	19/884	1	19/884	8/92	0/006	0/26	0/82
	Error	57/99	26	2/23				
	All	6284/75	30					

As shown in Table 1, mindfulness training is not effective in inhibiting responses, since the F calculated for response inhibition (F = 0.53 and η ^ 0.02) was not significant at the level of P<0.05, while the F calculated for selective attention was significant at P<0.05 (F = 8.92 and (η ^ 2 = 0.26).

Discussion and conclusion

The aim of this study was to investigate the effectiveness of mindfulness-based training on response inhibition and selective attention in students with Specific Learning Disabilities (SLD). The results showed that mindfulness-based training significantly improves the level of selective attention. Tang (2007) also showed that short-term mindfulness exercises (five days, 20 minutes per session) improve executive functions and selective attention in people without learning disabilities, thus explaining the present findings too. This study performed its intervention over eight sessions, each lasting 45 to 60 minutes.

According to our findings, mindfulness training did not improve inhibition response in students with SLD and no significant relationship was found between this variable and the intervention. According to Barkley (1997), response inhibition and working memory are both components of executive functions that are closely related to each other. In other words, inability to inhibit response leads to impaired memory function (Ghobari Bonab et al., 2013).

One of the limitations of the present study was the researchers' time constraints and the COVID-19 conditions, which meant that convenience sampling had to be used, thus limiting the generalizability of the findings. Further detailed studies are recommended to be conducted on students with SLD using other random sampling methods. According to our findings, mindfulness training can be used to improve selective attention in students with SLD in schools and improve academic ability as a low-cost option.

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