



## The Impact of Mandala Coloring on the Executive Functions of Children with ADHD

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### Abstract

**Objectives:** Attention Deficit Hyperactivity Disorder (ADHD) is a chronic and one of the most common neurodevelopmental disorders that can significantly increase the risk of other psychiatric disorders, academic and occupational failure, accident, delinquency, social disability and addiction during one's life. The aim of this study is to investigate the impact of mandala coloring on the executive function of the children with ADHD.

**Methods:** This is a pre/post-test quasi experimental study with a control group. In this study, 38 children with ADHD were randomly assigned to the intervention and the control groups. In order to measure the executive functions, the Behavior Rating Inventory of Executive Function (BRIEF) parent version was used. The mandala coloring program was performed in 10 sessions for the intervention group, while the control group received routine services. Then the data was analyzed by calculating the mean and the variance through applying ANCOVA, paired t-test and independent t-test.

**Results:** The data showed that mandala coloring had an impact on the executive function of the children with ADHD. In the intervention group, there was a significant difference in the mean score of executive function before and after the intervention ( $P < 0.001$ ), showing an improvement in the executive function in this group.

**Conclusion:** Mandala coloring improved children's executive functions, which can be a turning point in controlling the symptoms of children with ADHD.

**Keywords:** Attention deficit; Hyperactivity; Executive function; Psycho nursing; Art therapy

### Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a chronic and one of the most common neurodevelopmental disorders, the main symptoms of which include attention problems, impulsivity and hyperactivity. This disorder affects approximately 8%-12% of children worldwide, in up to 65% of which ADHD symptoms and neuropsychiatric disorders persist into adulthood, if not diagnosed and properly treated. The prevalence of ADHD increased from 6.1% in 1997-1998 to 10.2% in 2015-2016 in American children and adolescents. ADHD can significantly increase the risks of other psychiatric disorders, academic and occupational failure, accident, delinquency, social disability and addiction during one's lifetime. In addition, children with ADHD show poorer social and emotional performance compared to their peers and generally, experience more behavioral and emotional problems and a lower quality of life. Various studies have reported that people with ADHD have also problems with most of the abilities associated with executive functions. Executive functions play an important role in one's cognitive and behavioral performance, emotional control and social interactions. Executive functions are a type of self-regulating function demonstrating a child's ability of inhibition, planning, organization, using working memory, problem solving and setting goals to fulfill a variety of tasks and activities. If the executive functions are impaired, participation decreases and roles become limited which may even affect one's community living, independence and quality of life. Although evidence based therapies can reduce ADHD symptoms in a significant number of people, no definite cure for ADHD is yet discovered. In recent years, complementary and alternative treatments are becoming more popular as a supplementary and, in general, supportive therapy in many medical and healthcare centers.

Using mandala coloring (art therapy) as an adjunct therapy is relatively new and, therefore, few researches have been done on the subject. Art therapy is a type of psychotherapy that uses images and visual expression as a means of communication. Therapeutically, art facilitates self-realization and self-discovery. In particular, coloring therapy is a combination of art therapy with meditation. In various studies, many advantages of coloring as a care and therapeutic mechanism have been mentioned, including creating pleasure, increasing concentration, creating social opportunities and reducing stress and anxiety. Mandala coloring is one of the sub-branches of art therapy. Mandala is a compound word derived from the ancient Indian language, derived from the root manda meaning center and essence, plus the suffix la meaning container. Mandala, meaning circle in Sanskrit, is a spiritual symbol and creed. The complexity and the circular and geometric patterns of mandalas are therapeutically beneficial and enhance consciousness. Mandalas are circular geometric shapes, considered as universal symbols for spiritual growth or a form of visual meditation. Coloring the relatively complex, symmetrical and repetitive patterns of the mandala help one enter a state like meditation that improves the human spirit and helps repel negative thoughts and feelings. Mandalas are used in different religions as a tool for meditation and promoting psychotherapy and integrity. Carl Jung believed that artwork in a circle improves psychological well-being. Various studies have shown that drawing, coloring or tracking the structural pattern of mandalas reduce anxiety and negative emotions, which works through the meditative state these patterns create. Finally, due to the importance of executive functions in children and the poor executive functions in the children with

ADHD and high treatment costs, as well as the emergence of art therapy, and in particular mandala coloring as a novel and complementary treatment, this study aimed to investigate the impact of mandala coloring on the executive functions in the children with ADHD [1].

## Materials and Methods

### Research design

This study was a pre/post-test quasi experimental research with a control group. The study population consisted of 7 to 12 year old children with ADHD, in 2019. In this study, the samples were selected through convenient sampling. Then the samples were randomly assigned to an intervention and a control group, each with 19 subjects.

### Measure

To collect data, a demographic information questionnaire and the Behavior Rating Inventory of Executive Function (BRIEF) parent version were used [2]. BRIEF consists of 86 items. Each of the questions is related to one of the subclasses of the questionnaire and these sub-classes are divided into two main parts including behavioral regulation skills and metacognition skills as follows;

- **Behavioral regulation skills:** Inhibit, shift, emotional control.
- **Metacognitive skills:** Plan/organize, organization of materials, monitor, working memory, initiate.

The questionnaire items are scored on a likert scale as never:

- Sometimes.
- And most of the time.
- The higher one's score, the more impaired one's execution functions.

### Procedures

The questionnaires were completed by the parents before the intervention. After making coordinations, mandala coloring sessions were held once a week for a total of 10 sessions each 40-60 minutes for the intervention group subjects [3-6]. The control group received their routine treatments including oral medications at fixed doses. In this method, mandala coloring patterns were used for children. In order to hold sessions and maintain attention and concentration, the intervention samples were divided into 4 groups of 5-6 subjects. In the first session, the children got acquainted with the researcher and each other [7]. The reason for holding these sessions and the presence of children was explained to them clearly and simply. In each session, they were asked to use the provided crayons to color and complete a mandala design that was previously drawn on an A4 size sheet of paper. In mandala coloring sessions, the children had complete freedom in choosing colors and the coloring style. Each design was aimed to be a bit more complex than the one in the previous session. After the intervention, BREIF questionnaire was again completed by parents [8].

### Data analysis

To perform data analysis, the data obtained from the questionnaires filled out by the research subjects was collected and entered into SPSS V17. The results were analyzed through ANCOVA, paired t-test and independent t-test [9].

## Results

### Findings

This study was conducted among 38 children with ADHD. Based on the results of *Chi square* test, there was no significant difference in the frequency distribution of demographic characteristics including age, gender, grade, maternal and paternal education (Table 1).

Variable		Intervention group		Control group		χ <sup>2</sup>	P-value
		Number	Percentage	Number	Percentage		
Age	7-8	6	31.6	7	36.8	0.477	0.788
	9-10	11	57.9	9	47.4		
	10-12	2	10.5	3	15.8		
Gender	Female	6	31.6	7	36.8	0.117	0.732
	Male	13	68.4	12	63.2		
Educational grade	First-second grade of primary school	6	31.6	8	42.1	2.08	0.352
	Third-fourth grade of primary school	12	63.2	8	42.1		
	Fifth-sixth grade of primary school	1	5.3	3	15.8		
Father's education	Under diploma-diploma	8	42.1	7	36.8	1.24	0.536
	Of high school education-BSc	10	52.6	12	63.2		

	MSc-PhD	1	5.3	0	0		
Mother's education	Under diploma-diploma	9	47.4	9	47.4	2.22	0.329
	Of high school education-BSc	10	52.6	8	42.1		
	MSc-PhD	0	0	2	10.5		

**Table 1:** Demographic characteristics of children participating in the study.

With regard to the variables of executive functions, considering the normal distribution in both groups, paired t-test was used to compare the mean scores. In the executive function, it is observed that in the intervention group, the executive function has improved after the intervention and the paired t-test shows a significant difference ( $P < 0.001$ ) [10-12]. It can be said that mandala coloring has improved executive functions in children with ADHD. In the control group,

executive functions deteriorated after the intervention, though the difference between the mean scores pre-and post-intervention was not significant ( $P = 0.115$ ) (Table 2). The mean scores of the components of executive function including behavioral regulation skills and metacognition skills were measured and compared in order to closely determine the impact of the intervention on each of these two classes of executive function [13].

Executive function				
	Before intervention	After intervention	P-value	t
Intervention group	188.31 (37.44)	167.63 (30.04)	<0.001	4.56
Control group	183.31 (31.67)	186.21 (33.12)	0.115	1.65
p-value	0.659	0.079		
t	0.641	-2.607		

**Table 2:** Comparison of mean executive function before and after the intervention in intervention and control group.

According to Table 3, the mean score of behavioral regulation skills in the intervention group has significantly decreased compared to that of pre-intervention, which shows improved behavior regulation skills in children with ADHD ( $P < 0.05$ ). Moreover, in the control group, the mean score of behavior regulation skills was slightly reduced after the intervention, although the difference was not significant. There was no significant difference in the mean score of data between the control and the intervention groups prior to the intervention [14]. However, a significant difference was observed between the mean scores of the two groups ( $P < 0.05$ ).

In the intervention group, an improvement in metacognition skills was observed after the intervention and the results of paired t-test also showed a significant difference ( $P < 0.001$ ). Therefore, it can be said that mandala coloring has improved metacognitive skills in children with ADHD. In the control group though, the mean scores are not significantly different in pre and post-intervention ( $p = 0.239$ ). In addition, the mean score of metacognition skills in the intervention and the control groups were not significantly different prior to the intervention ( $P < 0.05$ ), but sufficiently differed after it (Table 3). It can be inferred that mandala coloring affected both metacognition skills and behavioral regulation skills, as the two components of executive functions, leading to an improvement in both of these subclasses [15].

	Behavioral regulation skills				Metacognitive skills			
	Before intervention	After intervention	p-value	t	Before intervention	After intervention	p-value	t
Intervention group	79.00 (15.39)	68.21 (13.15)	<0.001	5.02	109.31 (22.49)	97.21 (17.86)	0.001>	4.49
Control group	76.47 (13.17)	75.52 (13.69)	0.274	1.12	106.84 (19.44)	108.42 (20.22)	0.115	-1.21
p-value	0.051	<0.001			0.554	0.001>		
t	0.63	-2.09			0.603	0.239		

**Table 3:** Comparison of mean behavioral regulation skills and metacognitive skills before and after the intervention in intervention and control group.

The result of ANCOVA regarding the impact of variables on the variable function after the intervention shows that the pre- and post-intervention scores had a significant effect on the response ( $P < 0.05$ ).

The pre-intervention score of function accounts for 81% and the intervention score, 42% of the total variance of the scores of function (Table 4).

Source	Total squares	Freedom of degree	Mean squares	F-value	P-value	Eta effect size
Group	4865.001	1	4865.001	25.374	0	0.42
Executive function before intervention	29292.85	1	29292.85	152.778	0	0.814

**Table 4:** Covariance analysis results for the executive function after the intervention.

The result of ANCOVA for the effect of variables on the variable behavioral regulation skills after the intervention shows that the scores of behavioral regulation before and after the intervention had a significant effect on the response ( $P < 0.05$ ). The pre-intervention score of behavioral regulation accounts for 75% and the intervention score accounts for 34% of the total variance of the score of behavioral regulation (Table 5).

Source	Total squares	Freedom of degree	Mean squares	F-value	p-value	Eta effect size
Group	828.749	1	828.749	18.51	0	0.346
Behavioral regulation skills before intervention	4924.82	1	4924.82	109.994	0	0.759

**Table 5:** Covariance analysis results for the behavioral regulation skills after the intervention.

The result of ANCOVA for the effect of variables on the variable metacognition skill after the intervention shows that the scores of metacognition skill before and after the intervention had a significant effect on the response ( $P < 0.05$ ). The pre-intervention score of metacognition explains 81% and the intervention score explains 40% of the total variance of the score of metacognition skill (Table 6).

Source	Total squares	Freedom of degree	Mean squares	F-value	p-value	Eta effect size
Group	1652.035	1	1652.035	23.471	0	0.401
Metacognitive skills before intervention	10644.3	1	10644.3	151.229	0	0.812

**Table 6:** Covariance analysis results for the metacognitive skills after the intervention.

## Discussion

According to the data displayed in the following tables and the mean scores in the intervention group, children's executive functions have improved compared to the pre-intervention phase. In the control group, where no intervention is performed, the executive functions did not change significantly compared to pre-intervention. The results showed that this improvement in executive function was achieved in its both components including behavioral regulation skills and metacognition skills, and that mandala coloring intervention improves behavior regulation skills and metacognition skills in the children with ADHD. This finding is in line with the results of the other studies in this field. In 2015, Hina Ayaz Habib and Uzma Ali conducted a study to investigate the effectiveness of art therapy in reducing impulsive behaviors in the children with ADHD and Intellectual Disability (ID) in Karachi, Pakistan. The findings of this study showed that art therapy has been effective in reducing impulsive behaviors in children with ADHD and ID ( $P < 0.05$ ). The book entitled art therapy with diverse populations by Sangeeta Prasad and Paula Howie discusses the impact of mandalas on children with autism. At the end of this book, by discussing a real case where the

impact of mandala was studied on an autistic child, it was concluded that mandala has a machine like function resulting in self-expression, the facilitation of communication and an increase in social skills. Therefore, it was recognized as a useful treatment model for autistic children. Ghamari Givi, et al., also conducted a study to investigate the impact of mandala therapy on reducing anxiety among adolescents, the results of which showed that mandala coloring reduces anxiety among the subjects and has a greater impact compared to chess board coloring and free painting groups. In addition, Chado Liu, et al., conducted a study on 80 students in order to investigate the effect of mandala coloring on mindfulness, spirituality and subjective well-being, where the results showed that mandala coloring can have a positive impact on the three variables mindfulness, spirituality and subjective well-being and the researcher recommended to conduct similar studies in different conditions for ensuring the accuracy of results.

Those in favor of mandala aim to create integrity among ancient inner concepts, understanding and healing by exploring the roots of humans. Jung believed that when the ego disintegrates, mandala can establish a new connection between the ego and the self, reducing the distance between the conscious and the unconscious. It can bring the unconscious to consciousness, relieving the conscious pressure on the

mind. According to the law of exercise proposed by the behavioral theorist Edward Lee Thorndike, the more we repeat the stimulus with satisfying response, the more stable the stimulus response connection would become. Finally, it can be said that mandala can affect one's executive functions through affecting one's unconscious and inner self and by improving the ego and exercising it, which also makes the effect longer and more stable.

## Conclusion

Children with ADHD suffer from executive dysfunction. Executive functions play a very important role in psychological functions, communication and learning. The findings of this study showed that mandala coloring can be used as a part of the treatment protocol for improving executive functions in the children with ADHD at school age. Considering the vital and sensitive role of nurses in the treatment team, it is hoped that the results of this study will pave the way for better non-pharmacological approaches such as art therapy including mandala coloring, and thus will improve the health and the clinical condition of care seekers.

## Relevance for Clinical Practice

Mandala coloring can provide a non-pharmaceutical option for improving executive functions in the children with ADHD and considering the vital and sensitive role of nurses in the treatment team, they can benefit from the safe, cheap, and accessible alternative therapeutic strategy to improving the executive functions of children with attention deficit/hyperactivity disorder.

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## Conflict of Interest

The authors report no actual or potential conflicts of interest.

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