Effectiveness of mandala coloring and playing with Lego on children's preoperative anxiety: A Randomized Clinical Trial

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Abstract

Background: Mandala Coloring and Playing are distraction strategies to reduce the anxiety level in children. However, their effects are inconsistent and have received little attention for the management and prevention of anxiety in hospitalized children. The main objective of this study was to compare the effect of distraction strategies of Mandala coloring and playing with Lego on reducing preoperative anxiety in pediatric patients undergoing surgeries.

Methods: The study was designed as a randomized, single-blind, tree-arm, parallel-group controlled trial. There were 96 children aged 6 to 18 years who were admitted to the pediatric surgery ward in Mofid Children's Hospital in Tehran-Iran. Simple randomization was used for choosing the participants for dividing them into two intervention groups and one control group. The interventions (Mandala Coloring and Playing with Lego) lasted 15-20 minutes in Mandala and Lego groups. In the control group, they received care according to the ward's routine procedure. Anxiety as the main outcome variable was measured using the State-Trait Anxiety Inventory in two stages (Before the intervention and immediately after the intervention) for children. Analysis of variance was used to compare the means in the three groups, and Tukey's post-hoc test was used to assess the significance of differences between pairs of group means.

Results: Less state anxiety was observed after the intervention in the Lego group compared to the Mandala group (-4.69 ± 7.58, P =0.094). The data also revealed significant differences before and after the intervention in the Lego group in terms of preoperative trait anxiety (35.84 ±10.25 and 34.38 ± 8.89, respectively, P = 0.038).

Conclusion: The results demonstrated that playing with Lego and Mandala coloring, compared to the control group that received care, according to the ward routine procedure, had an effective role in reducing preoperative anxiety in children; however, playing with Lego had the most effect on decreasing anxiety state in children.

Highlights

What is current knowledge?

Playing with Lego can actually have a really calming and relaxing effect and can be helpful for hospitalized children who may have anxiety or worries. Playing and creating with Lego can bring a feeling of order to a chaotic or stressful day and have therapeutic benefits.

What is new here?

The data in this study showed that playing with Lego reduced state and trait anxiety in children compared to the Mandala coloring and control groups.

Introduction

Surgery is an unpleasant experience in the life of children and their families, which can be minor or major, invasive or non-invasive, and planned or emergency. Even minor surgery, can be a significant source of discomfort for children, with a certain degree of risk before entering the operating room and during the induction of anesthesia (1,2). Anxiety is one of the most common negative responses experienced before surgery. Researchers have estimated that almost 60% of children undergoing surgery experience excessive preoperative anxiety (3). Before surgery, the child may show anxiety by expressing fear, trembling, crying and restlessness, and even resistance to the treatment process and lack of cooperation (4). The occurrence of preoperative anxiety is affected by age, gender, first surgical experience, and parental anxiety (5). Routine procedures before surgery, such as wearing unfamiliar clothes, waiting to be transferred to the operating room, fear of surgery and anesthesia, separation from family members, possibility of disability, and fear of pain after surgery are among the factors that lead to ultimate anxiety in children (3,6,7).

Failure to manage preoperative anxiety has a negative impact on preoperative and intraoperative care, postoperative outcomes, child's behavior,

child's adaptation to the hospital environment, and the degree of child cooperation with the treatment staff. It may further cause adverse emotional and behavioral manifestations, more pain, and delay in recovery after surgery and it may increase the duration of hospitalization after surgery (8,9). Studies show that the use of non-pharmacological interventions, such as play therapy and creative arts, including coloring, reduces anxiety levels in children of all age groups (10-12). Coloring can be used as a non-verbal tool for children to express their thoughts and feelings and establish effective communication with the therapist (13). This method can reduce the child's anxiety (10). In Mandala coloring, coloring is done in nested circles that have one identifiable center point. This pattern makes the client focus on the act of drawing and clears his/her confusion. It can lead to psychological support and recovery (14,15). Overall, Mandala coloring is a safe and accessible activity that does not require special skills or training and can be used as a complementary strategy to reduce anxiety (16).

Another non-pharmacological intervention to reduce anxiety is play therapy. Playing games has a significant role in children's life, and nurses can use playing to reduce children's preoperative anxiety (3). Play therapy includes activities appropriate for the child's growth and development status (Such as toys, puppet therapy, storytelling, booklets with pictures of surgical equipment, etc.). It is one of the most effective interventions to emotionally help prepare children for surgery or health-related procedures and reduce or prevent their anxiety and pain (3,17,18). Lego games are in small forms, colorful plastic bricks that can be arranged in different ways depending on children's imagination and creativity. This toy and similar toys are effective in reducing the anxiety level of hospitalized children (17). The bright color of the Lego blocks leads to a psychologically positive effect on children and can occupy children's minds, reduce negative emotions, and improve their inner problems and/or anxieties (19).

Based on scientific evidence, playing and drawing can be effective interventions for reducing presurgical anxiety (20,21). However, there is limited evidence on the effect of playing with Lego sets (And similar building block toys) and Mandala coloring on anxiety, and there is no study about the effect of Playing with Lego on reducing anxiety in school-age children. However, the most effective non-pharmacological method of pain control in children is still

unknown. Therefore, the aim of this study was to compare the effect of Mandala coloring and playing with Legoson anxiety management before surgery. The primary objective was to compare the effect of Mandala coloring and playing with Lego on children's preoperative anxiety. The secondary objective was to associate the selected demographic variables with anxiety among hospitalized children.

Research hypothesis:

H1: There will be a significant difference in the level of preoperative anxiety between both intervention (Mandala coloring and playing with Lego) and control (Those who received care according to the ward routine procedure) groups.

Methods

The current study was a randomized, single-blind, tree-arm, parallel-group controlled trial conducted with the aim of comparing the effect of Mandala coloring and playing with Lego on reducing anxiety before surgery (e.g., appendectomy, umbilical hernia surgery, tonsillectomy, gastrointestinal surgery, orthopedics, genitourinary urination, adenoidectomy) in three groups of children from May 1 to August 25, 2022 in Iran. A total of 96 candidates for surgery who were admitted to two surgical wards of Mofid Children's Hospital affiliated with Shahid Beheshti University of Medical Sciences and met the inclusion criteria, were selected. They were assigned to three groups, including the Mandala coloring group (N=32), the Lego building block set group (N=32), and the control group (N=32) using simple randomization. The participants were allocated to the three groups using simple randomization by lottery method. This process was repeated until all participants were assigned to the three groups. Enrolling participants and assigning them to intervention and control groups were planned by the statistician who is a member of the research group (First author) and performed by the second author at that time.

The inclusion criteria for children were 6 to 18 years of age, full awareness of place, time, and persons, moderate to severe anxiety level based on Spielberger State-Trait Anxiety Inventory (STAI) before participation, the ability to communicate verbally, and having the physical strength to color Mandala designs and play with Lego. The exclusion criteria were suffering from mental or personality disorders (e.g., attention deficit hyperactivity disorder [ADHD], generalized anxiety disorder [GAD], etc.) based on patient's file, moderate to severe pain during the intervention (Measured with a visual numerical scale), the need for emergency surgery, child's restlessness, and unwillingness to continue the study.

Following a similar study by Moghimian et al. (2023), the sample size was estimated using the following equation: (18)

Where the probability of type 1 error was $Z_{\frac{\alpha}{2}} = 1.96$ for α = 0.5, the probability of type 2 error was $Z_{\frac{\beta}{2}} = 1.96$ for β= 0.5, the test power was equal to $1 - β = 0.08$, and the effect size was $\frac{(\mu_1 - \mu_2)}{\sigma} = 0.70$. Accordingly, with type 1 error of 0.05, type 2 error of 0.80, and confidence interval 0.95, the sample size was estimated at 32 persons per group:

$$n = 2(1.96 + 0.85)^2 \left(\frac{1}{0.70}\right)^2 = 32$$
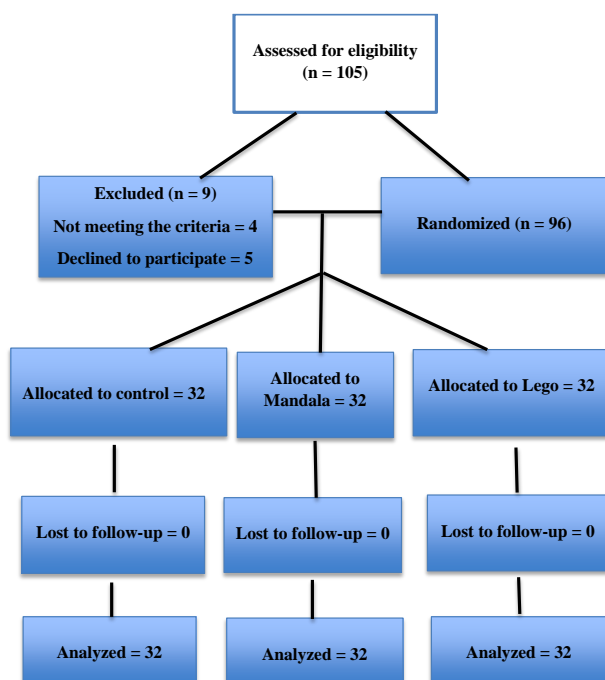
The consort flow chart is depicted in Figure 1.

Figure 1. The consort flow chart of the study

Data collection

The sampling was single-blinded (Children). It was done separately for each group on different days of the week so as to avoid children in the studied groups having contact with each other. At the time of data collection, by attending the waiting room of the children's hospital, the intervention method was explained to the children and their parents, and informed consent was received from the parents of the children to participate in the study. Allocation of the selected children into two intervention groups and one control group was based on the simple randomization by lottery method. To homogenize all groups before measuring preoperative anxiety, a brief explanation about surgery was given to children, so that all children would have information related to their surgery according to their age.

In the studied hospital, before entering the operating room, all children and their mothers waited in a room located near the operating room. In order to minimize contamination, ethical problems and uniform intervention, the Mandala coloring and play with Lego were carried out in the ward's playroom and only in the presence of the child, accompanying parent and researcher. Children in the three groups received no pharmacological interventions during this period. With the presence of their mothers, children in the two intervention groups were provided with the facilities to play with Lego and color Mandala patterns for 15-20 minutes. For children aged 6-10 years old, it may be difficult for them to understand the language description in the scale. Therefore, the anxiety questionnaire was individually explained to each participant, taking into account the child's age and comprehension level. This was done in the presence of the accompanying parent for both groups. Subsequently, the anxiety levels of children in three intervention and control groups were assessed using the Spielberger State-Trait Anxiety Inventory (STAI) and through interviews with the children by the researcher on two occasions before and after Mandala coloring and playing with Lego interventions for children.

For the children in the Mandala coloring group, five different Mandala designs were printed separately on a piece of paper (21× 7.29 cm). Before the intervention, the child's level of anxiety was assessed, and then a pack of 12 colored pencils was given to the child and he/she was asked to choose one of the designs of the Mandala painting and color it in 15 to 20 minutes. Anxiety was checked again immediately after the intervention. In the group playing with Lego, the child's level of anxiety was measured before the intervention, and then a box containing a number of bricks with different colors, sizes, and shapes was provided to the child and the child was asked to build one of the structures in the toy manual in 15 to 20 minutes. However, children could make changes in the shapes and forms according to their imagination. Anxiety was checked again immediately after the intervention. The children in the control group were invited to wait in the day surgery waiting room with their parents until surgery was ready to be performed and they received care according to the ward routine procedure and only their level of anxiety was measured and recorded at the same time intervals with the two intervention groups. After completing the research, some Mandalas and colored pencils and Lego's bricks were given to the control group to color and play with at home.

Demographic information questionnaire: The demographic information questionnaire included ten items on children's age, sex, education, history of surgery, type of surgery, and history of hospitalization.

Spielberger State-Trait Anxiety Inventory (STAI): The STAI was used to measure the level of anxiety in children. This instrument was designed by Spielberger in 1983, it measures the state and trait anxiety of patients (22). It consists of 20 items and examines the quality of tension, worry, anxiety, and anger based on a four-point Likert scale from 1 (Very little) to 4 (Very much). The total score of STAI was between 20-80. In this study, 80 was considered the highest score, while 20 was considered the lowest score (23). The STAI was standardized and culturally adapted for use in Iran by Roohy et al. (2005) and the reliability of the tool was reported as 0.90 (24). In the study conducted by Khademi et al. (2021), the reliability of the tool was confirmed with Cronbach's alpha of 0.92 (16). Qualitative content validity was assessed in the present study which showed no changes. To determine the reliability and internal consistency, the questionnaire was completed by ten children and its reliability was confirmed with Cronbach's alpha of 0.84.

Data analysis

The collected data were described using frequency, percentage, mean, and standard deviation. To compare and analyze the data, paired T-test and Tukey's post-hoc test were used. Moreover, repeated measures analysis of variance (ANOVA) was used to check the research hypotheses. Considering the normality of the variables based on the Shapiro-Wilk test, parametric tests were used to compare the three groups. Data were analyzed using SPSS-25 software at a significance level of p <0.05.

Results

The mean age of children in the Mandala coloring, Lego, and control groups was 9.88±2.56, 8.77±1.76, and 8.91±2.37, respectively. According to the ANOVA test, there were no statistically significant differences in terms of age, gender, type of surgery, etc. between the three groups (Table 1). Based on the results of independent samples T-test, the mean changes of state anxiety in the Mandala group (p=0.031), and the changes in trait anxiety in the control group were higher

in girls than boys (p=0.038). Trait anxiety changes had a significant relationship with age in the Mandala coloring group (p=0.006). There was no significant difference in state and trait anxiety changes in those with and without a history of surgery and hospitalization. Besides, first-born children had more anxiety score changes than third-born children.

As shown in Table 2 and 3, there was no statistically significant difference between the three groups in terms of state anxiety before the intervention. After the end of the intervention, there was a statistically significant difference between the three groups. Tukey's post-hoc test showed that the group playing with Lego had less anxiety than the Mandala and control groups (p=0.02). The paired T-test showed that there was a statistically significant difference in the anxiety changes before and after the intervention in the Mandala and Lego groups. There was no

statistically significant difference between the three groups in terms of trait anxiety before the intervention. After the end of the intervention, there was no statistically significant difference between the three groups. The paired T-test showed that there was a statistically significant difference in the trait anxiety changes before and after the intervention in the Lego game group (p <0.038). As is evident in Table 4, the state anxiety changes in the Lego game group were higher than in the other two groups. However, the analysis of variance test showed these changes were not statistically significant. The reduction of trait anxiety in the Mandala group was more than in the other two groups but the analysis of variance test did not show a statistically significant difference between the three groups.

Table 1. The participant's demographic characteristics

Variables		Groups			P-value
		Mandala N (%)	Lego N (%)	Control N (%)	
Gender	Female	14 (43.8)	12 (37.5)	13 (40.6)	χ^2 = 0.259 chi-square P = 0.96
	Male	18 (56.3)	20 (62.5)	19 (59.4)	
Age (Year)	6-12	30 (93.75)	29 (90.625)	28 (87.5)	χ^2=0.736 ANOVA P = 0.692
	13-18	2 (6.25)	3 (9.375)	4 (12.5)	
Type of surgery	Appendectomy	1 (3.1)	0 (0)	0 (0)	Fisher's exact test P = 0.613
	Umbilical hernia surgery	1 (3.1)	1 (3.1)	2 (6.3)	
	Tonsillectomy	0 (0)	0 (0)	1 (3.1)	
	Gastrointestinal surgery	13 (40.6)	13 (40.6)	10 (31.3)	
	Adenoidectomy	0 (0)	1 (3.1)	1 (3.1)	
	Orthopedics	8 (25)	4 (12.5)	10 (31.3)	
	Genitourinary urination	9 (28.1)	13 (40.6)	8 (25)	
History of hospitalization	Yes	20 (62.5)	26 (81.3)	23 (71.9)	χ^2 ==2.783 chi-square P = 0.272
	No	12 (37.5)	6 (18.8)	9 (28.1)	
History of surgery	Yes	13 (40.6)	18 (56.3)	17 (53.1)	χ^2 ==1.750 chi-square P = 0.522
	No	19 (59.4)	14 (43.8)	15 (46.9)	
State anxiety before the intervention	Very little Little Much Very much	11 (34.4) 4 (12.5) 5 (15.6) 12 (37.5)	4 (12.5) 8 (25) 7 (21.9) 13 (40.6)	4 (12.5) 2 (6.3) 13 (40.6) 13 (40.6)	ANOVA P = 0.06

Table 2. Comparison of state and trait anxiety in the three groups before and after the intervention

State anxiety	Group			ANOVA test
	Mandala	Lego	Control	
	Mean ± SD	Mean ± SD	Mean ± SD	
Before the intervention	47.13 ± 10.86	42.50 ± 13.70	45.87 ± 11.74	f=1.239, P = 0.294
Immediately after the intervention	44.34 ± 9.37	37.81 ± 11.45	44.75 ± 11.81	f=4.061, P = 0.02
Paired t-test	t=2.234, df=31, P =0.033	t=3.497, df=31, P =0.001	t=1.472, df=31, P =0.151	-
Trait anxiety				
Before the intervention	42.22 ± 13.29	35.84 ± 10.25	36.88 ± 10.30	f=2.898 P = 0.06
Immediately after the intervention	40.09 ± 10.91	34.38 ± 8.89	36.59 ± 10.41	f=2.425 P = 0.07
Paired t-test	t=1.397, df=31, P = 0. 172	t=2.166, df=31, P = 0.038	t=0.678, df=31, P = 0.503	-

Table 3. Comparison of anxiety in the three groups in different stages

		Control group	Mandala group	Lego group	$P_{CM}{}^{*}$ (MD)	$P_{CL}{}^{**}$ (MD)	$P_{LM}{}^{***}$ (MD)
		Mean ± SD	Mean ± SD	Mean ± SD			
State	Before the intervention	45.87 ± 11.73	47.12 ± 10.86	42.50 ± 13.70	0.911 (-1.25)	0.510 (3.37)	0.286 (-4.62)
	Immediately after the intervention	44.75 ± 11.80	44.34 ± 9.36	37.81 ± 11.45	0.988 (0.40)	0.034 (6.93)	0.049 (-6.31)
Trait	Before the intervention	36.87 ± 10.30	42.21 ± 13.29	35.84 ± 10.25	0.150 (-5.34)	0.930 (1.03)	0.069 (-6.37)
	Immediately after the intervention	36.59 ± 10.41	40.09 ± 10.90	34.37 ± 8.88	0.353 (-3.50)	0.656 (2.21)	0.066 (-5.17)

*p-value (Mean differences) for comparing the control and Mandala groups
**p-value (Mean differences) for comparing the control and Lego groups
***p-value (Mean differences) for comparing the Lego and Mandala groups

Table 4. Comparison of state and trait anxiety changes in the three groups

Anxiety score changes	Group			ANOVA test
	Mandala	Lego	Control	
	Mean ± SD	Mean ± SD	Mean ± SD	
State	-2.78 ± 7.04	-4.69 ± 7.58	-1.13 ± 4.32	f=2.425 P =0.094
Trait	-2.13 ± 8.61	-1.47 ± 3.84	-0.28 ± 2.34	f=0.890 P =0.414

Discussion

The results of the present study showed that the studied children in the intervention and control groups did not have statistically significant differences in terms of demographic characteristics. Moreover, the three groups were similar in terms of clinical characteristics. Based on the obtained results, there was a statistically significant difference in the changes in state anxiety before and after the intervention in the Mandala coloring and Lego groups. The results of this study were similar to those of the study by Rajeswari (2019) and Ünver (2020) on the effectiveness of play therapy on preoperative anxiety in children as well as Faruzandeh's study (2020) which investigated the effect of painting on preoperative anxiety in children (3,25,26). In Khademi et al.'s study (2021), Mandala coloring was proved effective in reducing anxiety and hence introduced as an effective method to reduce anxiety in children (16). In the study by Vagnoli (2019), a significant difference was found in children's preoperative anxiety levels after the implementation of the guided imagery intervention by creating physiological relaxation (27). This similarity between the results of the present study and the mentioned studies may indicate that children in different cultures respond similarly to the conditions before or after surgery (28). Therefore, playing with Lego and Mandala coloring, as non-pharmacological interventions that cause distraction, divert children from the stressful situation of surgery and are effective in reducing anxiety before surgery. On the other hand, the results of the study by Babaei et al. (2021) and Al-yateem (2016) did not show a significant relationship between preoperative anxiety levels in children in the intervention group (29,30). This inconsistency can be because, in the present study, Mandala coloring was used to reduce anxiety, while in the mentioned studies the effect of painting therapy on reducing anxiety was investigated. The anxiety-reducing effects of Mandala coloring are stronger than in normal painting (31). In addition, based on the findings of the review study by Abbing (2018), the effectiveness of art therapy on anxiety has been studied in a limited way and there is no clear and strong evidence that this method is effective in reducing the severity of anxiety symptoms. Therefore, further trials are needed to investigate the effect of art therapy on anxiety (32). Furthermore, in this study, the Lego game group reported less state anxiety than the Mandala coloring and control groups. In Chow's (2016) systematic review of children's preoperative preparation, audio-visual interventions were introduced as potentially useful tools to reduce anxiety and it was suggested that films, multimodal programs, and games are the most effective interventions (33).

According to the results of this research, after the end of the intervention, there was no statistically significant difference between the three groups in terms of trait anxiety. The reason for this result might be attributed to the effects of the social conditions of children and their families. In the present study, factors such as parents' anxiety and the economic status of the family, which may be considered predictors of preoperative anxiety in children (34), were not investigated. It is necessary to pay attention to these intervening factors in future studies. It is also possible that the duration of these interventions was another reason for the lack of correlation between the levels of this type of anxiety. Based on the results of the studies, intervention at least one day before the surgery or with a longer duration causes a significant reduction in the child's anxiety level (28,35). In this study, there was a statistically significant difference in trait anxiety before and after the intervention in the group playing with Lego sets which was contradictory to the results of Härter's study (2021) on the effect of educational videos on preoperative anxiety in children (36). The mentioned study showed that despite showing educational videos about the operation, trait anxiety remained constant with no statistically significant difference. According to Härter, trait anxiety represents a stable personality trait, thereby following a stable course (36). The use of educational videos can reduce preoperative anxiety in children by leveraging audio-visual effects, providing information to the patients, and preparing them through increasing awareness. Furthermore, the difference in anxiety measurement tools is also effective in investigations of preoperative anxiety. In general, based on the findings obtained from the present study, it can be concluded that Mandala coloring and playing with Lego were effective in reducing state anxiety, and playing with Lego was effective in reducing trait anxiety. Nevertheless, state anxiety was less in the Lego group than in the Mandala group.

Conclusion

The results of the present study showed that playing with Lego reduced state and trait anxiety in children compared to the control group. The results also revealed the Mandala coloring intervention was effective in reducing state anxiety but ineffective in decreasing trait anxiety. Finally, this study indicated that playing with Lego and Mandala coloring as non-pharmacological, cheap, safe, and easy interventions can reduce preoperative anxiety in children. Therefore, it is recommended to use these non-pharmacological interventions as a supplement to the common methods of managing preoperative anxiety in children. The participants were selected using available sampling and only from a center affiliated to Mofid Children's Hospital, caution must be exercised in generalizing the findings to the entire society due to the differences in the treatment and care routines of each hospital. Besides, the differences in personal characteristics as well as cultural and ethnic factors might have influenced the perception of anxiety. Other limitations of this study included the implementation of interventions on the day of surgery only once and failure to measure parental anxiety. Thus, future studies need to pay attention to parental anxiety and intervening factors and perform interventions in different time periods before surgery.

Ethical statement

Ethical principles have been fully observed in this research. All experimental protocols were approved by the Vice-Chancellor for Research and Technology of Shahid Beheshti University of Medical Sciences with the ethics code: IR.SBMU.RETECH.REC.1400.975 and the IRCT code IRCT20220203053920N1. Informed consent was obtained from all subjects and/or their legal guardian(s) and participants could quit the study any time that they wished to, and all data entered were confidential.

Conflicts of interest

The authors declare no conflict of interest.

Author contributions

This manuscript is the consequence of the collaboration of all the authors RMS and ASF designed the study and wrote the study proposal, and FA and ZM conducted data collection. MJB and AO analyzed the data, and RMS and FA wrote the final draft of the manuscript and prepared tables. RMS submitted the document to the journal. The authors read and approved the final manuscript.

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