

Comparing the Effect of Music and Puzzle-Solving on Anxiety Before Surgery in Children: A Randomized Clinical Trial

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What is already known on this topic?

- In general, aggressive interventions such as surgeries can be stressful for children, and using methods such as simple games and music can be effective in reducing stress.*

What this study adds on this topic?

- Music therapy and puzzle-solving are effective adjunct treatments for reducing anxiety in children before tonsillectomy.*
- In general, it is recommended that nurses and healthcare workers take advantage of non-invasive care such as listening to music and puzzle-solving to provide appropriate medical care for children before tonsillectomy.*

ABSTRACT

Objective: Hospitalization and the possibility of surgery are known as the main causes of anxiety in children, and anxiety is a natural physiological process in individuals that allows them to adapt and deal with a diversity of adverse conditions. The purpose of this research aimed to compare 2 methods of distraction including puzzle-solving and music on anxiety before pediatric surgery.

Materials and Methods: This study is clinical trial research. First, 90 children 6 to 10 years old were randomly assigned to the intervention and control groups. In group A, the visual puzzle-solving items were presented, in group B, music with related pictures via a tablet was presented in the waiting room for surgery, and in group C, only standard care for each patient was presented. Anxiety before surgery was measured with a Children's Fear Scale questionnaire before moving the patient to the operating room, then 30 minutes before surgery in the pre-surgery waiting room, and the third stage immediately after transfer to the operating room before induction of anesthesia. Data were analyzed by one-way analysis of variance, chi-square test, and Tukey test using Statistical Package for the Social Sciences software version 21.0.

Results: The results of this research showed that the levels of anxiety significantly improved in the intervention groups compared to the control group after the intervention ($P < .001$).

Conclusion: Music and puzzle-solving as complementary therapy can improve the levels of anxiety in children before surgery. Therefore, this technique can be recommended to be used along with modern medicine in children.

Keywords: Anxiety, distraction, music, puzzle-solving, tonsillectomy

INTRODUCTION

Anxiety in children can occur as a result of various factors; hospitalization and surgery are considered anxiety conditions in childhood.¹⁻³ This feeling of fear and anxiety is a major obstacle to achieving the desired therapeutic goals of postoperative rehabilitation.⁴ In the study by Liu et al.⁴ it ranged from 41.7% to 75.44% of children undergoing surgery suffer from preoperative anxiety.

Anxiety is a natural physiological process in individuals that allows them to adapt and deal with a variety of adverse conditions.⁵ Preoperative anxiety prolongs the duration of hospitalization and also increases the need for analgesics and anesthetics. Sometimes preoperative

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sedatives have side effects, such as respiratory depression and drowsiness, that can justify the use of non-pharmacological methods.⁵⁻⁷ In general, anxiety can significantly increase the length of hospital stay of patients, so early diagnosis and treatment of anxiety can reduce the length of hospital stay.⁸

Cognitive behavioral therapy (CBT) and distraction are classified as non-pharmacological methods for reducing anxiety. Cognitive behavioral therapy has shown consistent superiority in randomized controlled trials.^{9,10} Among CBT methods, distraction has received more attention than listening to music and can be considered as one of the methods of deviation of thought.¹¹ The use of video game playing has also increased among children,¹² and distraction is a common non-pharmacological treatment that has been adopted by healthcare providers as well as families. In this technique, by changing the child's focus to something attractive, the child is prevented from paying attention to painful stimuli, and the child's anxiety is prevented.¹³ Another method that is used for distraction is puzzle-solving which is one of the active distraction techniques that can occupy the child's mind.¹⁴

Considering that pre-surgery anxiety is an inevitable thing for children with surgical cases, and not paying attention to the necessary measures to reduce anxiety can lead to dissatisfaction among the child and parents; therefore, it is necessary to use effective measures to reduce the feeling of anxiety in the child. Since the purpose of this study is to compare 2 methods of distraction on anxiety and physiological symptoms in children, this study was aimed at comparing the effects of puzzle-solving and music therapy on preoperative anxiety in children before tonsillectomy.

MATERIALS AND METHODS

Before the beginning of the study, all children and their parents were provided with clear statements of the study aims and methodology and the probability of exclusion from the research. Then, they were assured of the confidentiality of the information and the anonymity of the questionnaires. Subsequently, written consent was obtained from their parents. The Ethics Committee of Arak University of Medical Sciences, Arak, Iran, approved this study on June 23, 2019. The ethical code of this study is IR.ARAKMU.REC.1398.093.

Design

This is a randomized controlled trial done from October 2019 to September 2020. Enrollees consisted of 90 children 6 to 10 years old at Amir-Kabir Hospital, Arak, Iran. Considering a CI of 5% and a power of 80% and based on the results of the study by Canbulat et al.¹⁵ the sample size was calculated to be 90 (n = 30 in each group).

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 (S_1^2 + S_2^2)}{(\mu_1 - \mu_2)^2} \sqrt{k-1}$$

$$\frac{(1.96 + 1.282)^2 \times (1.20^2 + 1.30^2)}{(1.10 - 2.41)^2} \sqrt{3-1} = 27.10$$

$$\alpha = 0.05$$

$$\beta = 0.2$$

$$S_1 = 1.20$$

$$S_2 = 1.30$$

$$D = 2.03$$

$$k = 3$$

$$n_1 = n_2 = n_3 = 30$$

Blinding and Randomization

The sample was opted using convenience sampling and then distributed into 3 groups puzzle-solving (A), playing music (B), and control (C) using blocked randomization. To do this, all 30 possible permutations (i.e., CCA, CAB, ABC) within each block were first determined and then written on the uniform paper strips which were placed in a sealed cover. The paper slips were randomly picked up to specify the succession of participant allocation in the groups.

Our research was single-blinded because the researcher measured the patient's anxiety level through the Children's Fear Scale (CFS) questionnaire was heedless of the kind of intervention performed.

Participants

The study population was children referred to Amir-Kabir Hospital affiliated with Arak University of Medical Sciences. Inclusion criteria included the following: (i) age 6-10, (ii) being alert and aware of time and place, (iii) admission to the hospital for tonsillectomy, (iv) being able to communicate verbally, (v) not having a hearing problem, (vi) his first surgical experience, and (vii) not having a mental problem; the patients were excluded if their surgery was canceled. Children were separated from their parents when they entered the reception area of the operating room.

Diagnostic Procedure

In this study, children who had problems with tonsil enlargement were visited by the relevant specialist, and after clinical examinations and laboratory tests were performed, if they needed surgery, they were admitted to the hospital also with the inclusion criteria they entered into our research.

Data Collection Tools

In this study, information was gathered through a demographic questionnaire and CFS anxiety scale. Children's Fear Scale was used to appraise the level of anxiety in children. Children's Fear Scale is a 0-4 scale showing 5 cartoon faces (Figure 1) that range from a neutral expression (0 = no anxiety) to a frightened face (4 = severe anxiety) (as shown later).¹⁶ The validity and reliability of the CFS Anxiety Scale have been authenticated in various kinds of research.^{17,18}

In the study of McMurtry et al.¹⁶ interrater reliability (Time 1: rs = 0.51, $P < .001$) and test-retest reliability (rs = 0.76, $P < .001$) of the CFS were evaluated. Assessment of construct validity revealed high concurrent convergent validity with another

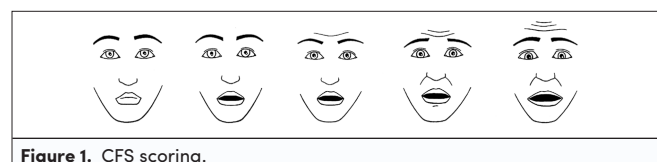


Figure 1. CFS scoring.

self-report measure of fear (Time 1: $r_s = 0.73, P < .001$) and moderate discriminant validity (e.g., Time 1: $r_s = -0.30, P < .005$ with child coping behavior; $r_s = 0.41, P < .001$ with child distress behavior).

Intervention

In group A, the researcher presented the visual puzzle-solving items via a tablet (by identifying the difference between 2 images); in group B, music with related pictures was played via a tablet in the waiting room for surgery; in group C, only standard and common care before surgery for each patient was provided. Anxiety was measured by the researcher before moving the patient to the operating room, then 30 minutes before surgery in the pre-surgery waiting room, and the third stage immediately after transfer to the operating room before induction of anesthesia. The puzzle-solving program and video music are in Persian and from the products of Soroush Audio-Video Company (affiliated with the Islamic Republic of Iran Broadcasting). In the intervention group, the music video and the video puzzle are done equally for the ages of 6-10 years.

Statistical Analysis

First, data were entered into IBM Statistical Package for the Social Sciences Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA) and then analyzed by inferential and descriptive statistics. The level of significance was propounded as $P < .05$. The Kolmogorov-Smirnov test and the Shapiro-Wilk test were utilized to test the normality of the data. The Kruskal-Wallis test was performed for the comparison of more than

2 independent groups that do not show normal distribution. The chi-square test was used to compare the nominal data. Repeated measure analysis of variance (ANOVA) was used to test whether there are statistically significant differences in anxiety that we used the repeated measures ANOVA test for mean differences between groups with more than 2 dependent normality distributions. The one-way ANOVA test is used for the mean differences between more than 2 independent groups with homogeneity of variance and distribution of normality, and Tukey tests were used to compare the mean scores of anxieties.

RESULTS

The CONSORT Follow-Up Diagram

Of the 126 qualified patients, 27 did not meet the inclusion criteria and 9 declined to participate. Of the remaining 90 patients, all met the study protocol and were included in the final analysis (Figure 2).

Demographic Characteristics

Anxiety Score. Fifty-nine percent and 41% of the contributors were females and males, respectively. The mean age of the patients in the music group was 6.23 ± 1.81 , the puzzle group was 7.53 ± 2.22 , and the control group was 7.56 ± 2.07 . Most children (65.5%) had the disease for less than 2 years. Patients in the 3 groups were homogeneous in terms of disease and demographic characteristics (Table 1) and with the Bonferroni correction for multiple tests for the age of participants,

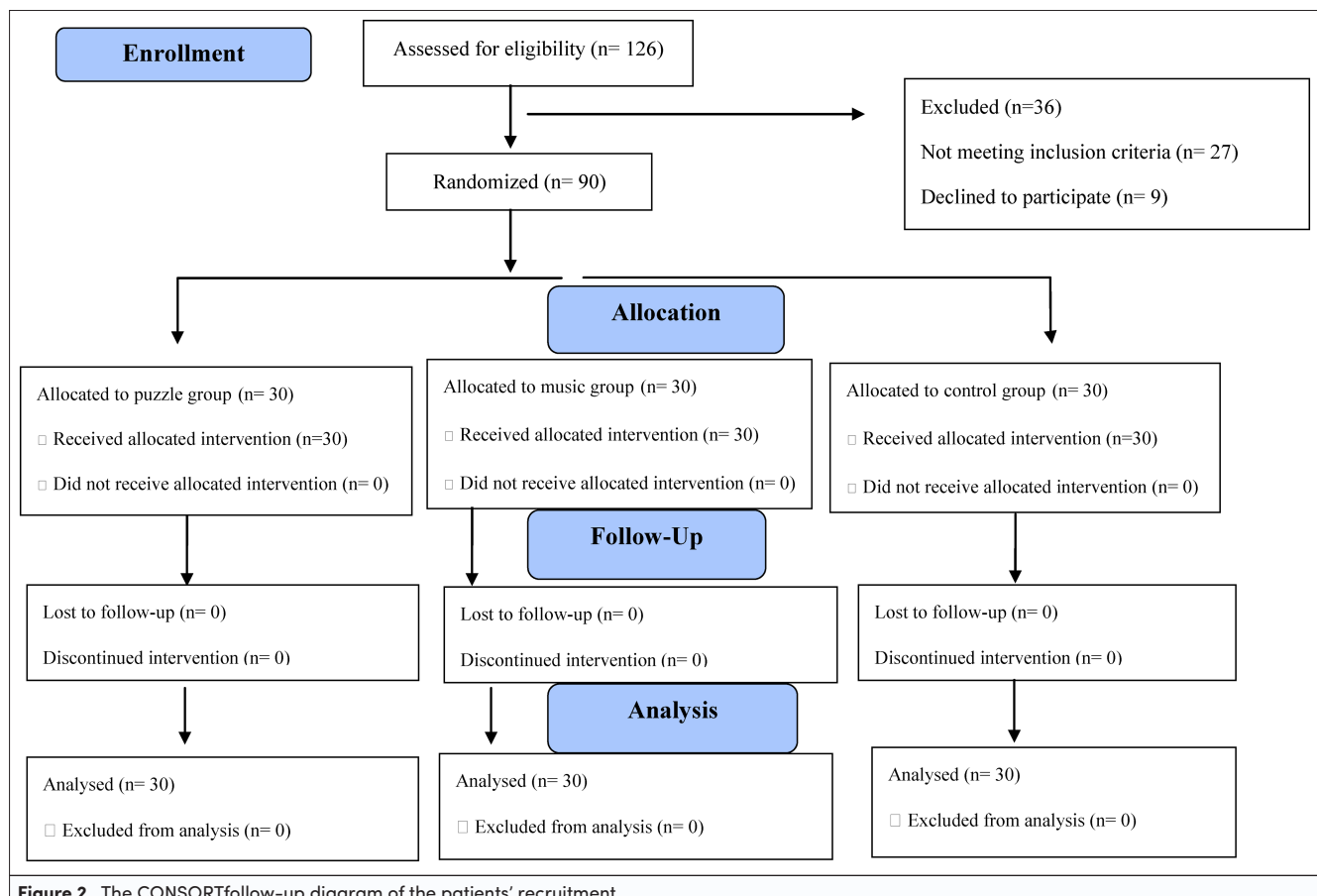


Figure 2. The CONSORT follow-up diagram of the patients' recruitment.

Table 1. Comparison of Demographic Characteristics in the Music, Puzzle, and Control and Groups

| Variable | | Music Group (n = 30) n (%) | Puzzle Group (n = 30) n (%) | Control Group (n = 30) n (%) | P |
|------------------------------|---------|----------------------------------|-----------------------------------|------------------------------------|------|
| Sex | Male | 14 (46.7) | 14 (46.7) | 9 (30) | .317 |
| | Female | 16 (53.3) | 16 (53.3) | 21 (70) | |
| Place of living | City | 22 (73.3) | 20 (66.7) | 22 (73.3) | .805 |
| | Rural | 8 (26.7) | 10 (33.3) | 8 (26.7) | |
| Disease duration (months) | 0-24 | 22 (73.3) | 19 (63.3) | 18 (60) | .705 |
| | 24.1-48 | 5 (16.7) | 6 (20) | 5 (16.7) | |
| | >48 | 3 (10) | 5 (16.7) | 7 (23.3) | |
| Age (year): median (25p-75p) | | 4.75 (6-8) | 6 (7.5-9.25) | 6 (7.5-8) | .027 |

significant values were reported between the groups of music-control and between the groups of music-puzzle, P : .088 and P : .043, respectively, which was insignificant in the music-control group and significant in the music-puzzle group. In general we understood that by repeated measures and by adjusting for the effect of age on results, the age did not affect our results.

The Anxiety of Patients Before and After the Intervention in 3 Studied Groups. The difference in the mean anxiety immediately before transferring the patient to the operating room in the ear, nose and throat (ENT) ward was not statistically significant between the 3 groups (P = .119). However, mean anxiety in 3 groups 30 minutes before surgery in the waiting room and immediately after transfer to the operating room, and before

induction of anesthesia was statistically significant (P < .001). The mean anxiety of patients at the 3 time points is presented in Table 2 and Figure 3.

Also, analysis of the results through Tukey's post hoc test showed the significance of the studied groups (P < .001) (Figure 4).

DISCUSSION

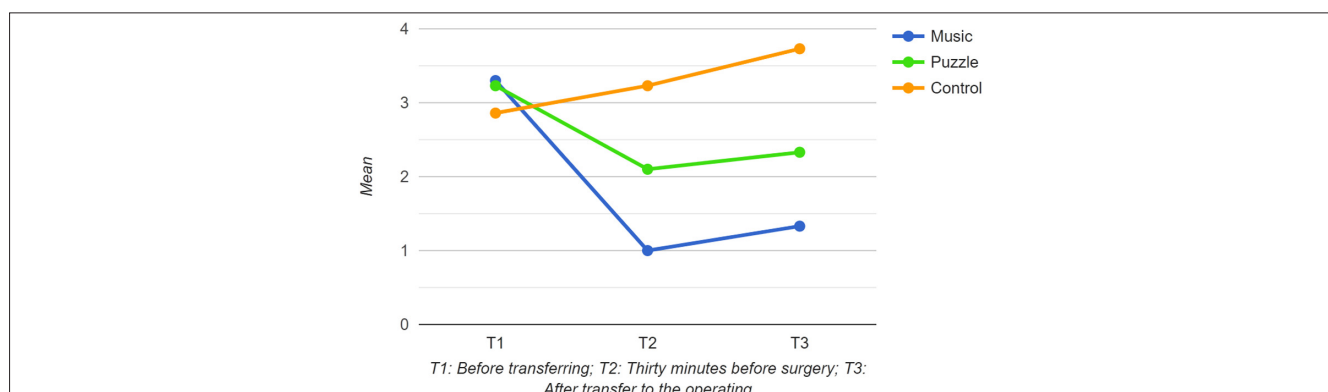
Our research was conducted to compare the effects of music therapy on anxiety in children before tonsillectomy. Based on the results, it was found that music therapy and puzzle-solving both can reduce anxiety in children before tonsillectomy. Montero-Ruiz et al.¹⁹ applied music therapy as an effective adjunct therapy in children with cystic fibrosis. In the study by Aghili et al.²⁰ it was shown that music therapy is effective in reducing anxiety in children undergoing dialysis. Karbandi et al.²¹ also showed that music therapy reduces the level of anxiety in hospitalized children. Therefore, the results of the abovementioned studies are consistent with the results of the present study in terms of the effect of music therapy on the level of anxiety in children. In the study by Huang et al.²² it was found that the use of music therapy can reduce preoperative anxiety and is effective in improving the effectiveness of anesthesia induction.

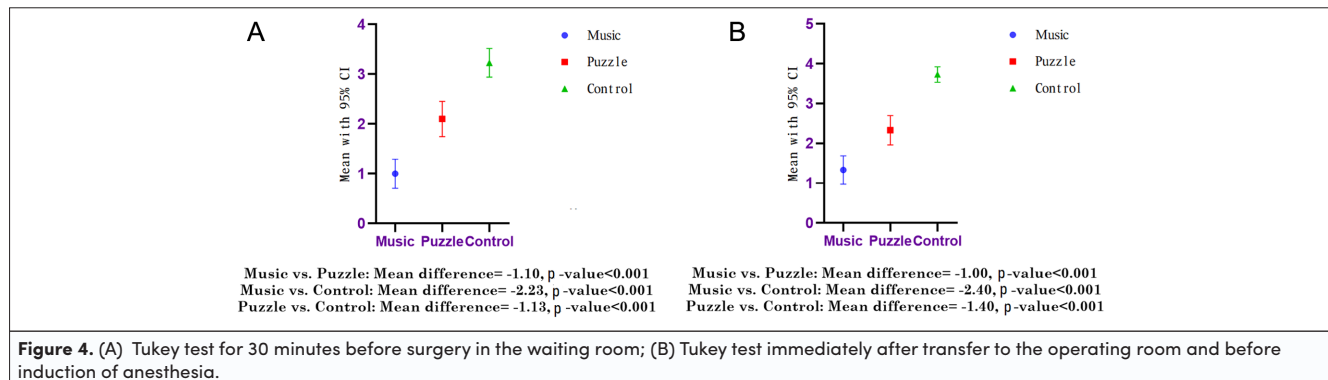
In another study by Pérez-Eizaguirre et al.²³ it was found that music therapy can have a significant effect on the level of anxiety among socially vulnerable groups and lead to a decrease in the level of anxiety. Generally, it can be acknowledged that music can be used as a non-invasive treatment method to reduce anxiety in the process of hospitalization and surgery.

Table 2. Comparison of Mean Anxiety of Patients Before and After the Intervention in 3 Studied Groups

| Intervention Times | Music Group | Puzzle Group | Control Group | P* |
|---|---------------------------|---------------------------|---------------------------|-------|
| | Mean ± Standard Deviation | Mean ± Standard Deviation | Mean ± Standard Deviation | |
| Immediately before transferring the patient to the operating room in the ENT ward | 3.30 ± 0.87 | 3.23 ± 0.77 | 2.86 ± 0.93 | .119 |
| Thirty minutes before surgery in the waiting room | 1 ± 0.78 | 2.10 ± 0.95 | 3.23 ± 0.77 | <.001 |
| Immediately after transfer to the operating room and before induction of anesthesia | 1.33 ± 0.95 | 2.33 ± 0.99 | 3.73 ± 0.52 | <.001 |
| P** | <.001 | <.001 | <.001 | |

*Analysis of variance (ANOVA); **repeated measure ANOVA.

**Figure 3.** The mean score anxiety at 3 time points in 3 groups.



Also, the results of our study indicated that using puzzle-solving can be effective in reducing anxiety before tonsillectomy. The results of many studies have shown that puzzle-solving is efficacious in reducing anxiety in children with cancer.²⁴ The positive effect of puzzle-solving on anxiety has been also proven in some other studies. Ball²⁵ considered the puzzle as a playing tool in psychiatry to improve preschoolers' development. Ramdaniati and Hermaningsih²⁶ also found that play puzzle therapy can reduce anxiety in hospitalized preschoolers.

Different research has been conducted to investigate the effect of other methods of distraction on children's anxiety. In a systematic review by Godino-láñez et al²⁷ entitled "Play Therapy as an Intervention in Hospitalized Children," it was revealed that play therapy can reduce postoperative pain, improve behavior and attitude, and reduce anxiety in children during hospitalization. Ibrahim et al.²⁴ in a systematic review, introduce play therapy as a simple technique for hospitalized children because it requires no special tool and can be used in preschoolers and school-aged children. Play therapy can include painting, puzzle-solving, and storytelling. Kaluas et al²⁸ stated that puzzle-solving has a significant effect on reducing the negative effects of hospitalization in children.

In another study conducted by Soniya et al.²⁹ the results showed that the use of games can be effective in reducing the anxiety of hospitalized preschool children, and this method is considered a non-invasive and non-pharmacological method.

The results of most studies in this area are consistent with the results of our study. Music therapy and puzzle-solving are available, affordable, and simple methods of keeping the child away from irritating feelings, anxiety, and adverse physiological consequences. It can be acknowledged that these methods can be approved and used as one of the treatment methods to relieve anxiety in children.

However, one of the limitations was the possible effect of confounders on the dependent variables of the study. To eliminate this limitation, patients were selected randomly. Another limitation was the small sample size, which can restrict the generalizability of the study results.

CONCLUSION

The results of this study support the beneficial effects of music and puzzle-solving on anxiety control. Music and puzzle-solving are appropriate and safe interventions to create a sense of calmness and improve anxiety before surgery in children.

Based on the results, it was found that music therapy and puzzle-solving both can reduce anxiety, while the music therapy group was relatively more effective on anxiety. This method can be used as a complementary, non-invasive, and cost-effective treatment along with other treatments for reducing anxiety before pediatric surgery. However, it is suggested that more research be done in this context.

Data Availability Statement: Data are available as per your request.

Ethics Committee Approval: This study was approved by the Ethics Committee of Arak University of Medical Sciences, Arak, Iran (IR.A.RAKMU.REC.1398.093).

Informed Consent: Written informed consent was obtained from the patients' parents who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Design – M.G., M.H.; Writing; M.G., D.H., T.H.; Data Collection and/or Processing – M.A., H.J., N.B.; Analysis and/or Interpretation – M.A., H.J., N.B.; Critical Review – M.G., M.H., D.H., T.H., M.A., H.J., N.B.

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Declaration of Interests: The authors declare that they have no competing interest.

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