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Effectiveness of stress ball and relaxation exercises on polymerase chain reaction (RRT-PCR) test-induced fear and pain in adolescents in Türkiye

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ABSTRACT

Purpose: This study aimed to determine the effectiveness of stress balls and relaxation exercises in relieving PCR test-induced fear and pain in adolescents.

Design and methods: A randomized controlled experimental study with a parallel-group design was conducted. The sample size was determined by G*Power analysis, and 32 adolescents were included in each group accordingly. The data were collected using the Adolescent and Parent Information Form, The Children's Fear Scale, and The Wong-Baker Faces Pain Scale. Descriptive statistics, t-test, paired t-test, ANOVA, and Tukey's forward analysis were used to analyze the data.

Results: The mean age was 14.93 ± 2.07 years for the adolescents, 43.58 ± 4.50 years for the mothers, and 48.25 ± 4.92 years for the fathers. Adolescents were stratified according to age, gender, and fear of invasive procedures, and homogeneity was ensured in their distribution to the groups. The pre-procedural level of fear was moderate in each group with no significant difference ($p > 0.05$). However, a significant difference was found between the groups in terms of both post-procedure levels of fear and pain. The pre-procedural fear of the adolescents in the control group (3.91 ± 0.29) did not change much after the procedure (3.91 ± 0.30), while there was a decrease in the other groups. The least post-procedure fear (0.09 ± 0.29) and pain (0.44 ± 0.67) were found to be in the relaxation exercise group.

Conclusions and practice implications: Relaxation exercise is the most effective method to reduce fear and pain during the PCR procedure. It is recommended to use it during the PCR procedure for being easily accessible, applicable, and cost-effective.

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Introduction

The World Health Organization's (WHO) diagnostic guidelines for the Covid-19 virus recommend a nucleic acid polymerase chain reaction (PCR) test that "amplifies a specific viral gene sequence (WHO, 2020). This is a test that many people have never had in their lifetime and is therefore unknown. Whatever the subject, the unknown causes stress and fear. If the suspicion of disease is added to this situation, it can

become even more serious. Therefore, PCR testing can lead to many problems, especially fear and pain (Elçigil, 2011).

UNICEF emphasizes that understanding the reactions and emotions of adolescents during the pandemic is essential for the protection and maintenance of their health (UNICEF, 2022). If adolescents are appropriately supported by healthcare professionals, their families, and educators during this process, they can overcome the distressing situation and be protected emotionally and physiologically (Pettoello-Mantovani et al., 2019). The health professional that the patient can reach most easily before, during, and after the test is the nurse. In this period, the nurse may need to support the applicants to keep their fear levels under control and support fear management to conclude the test in a short time and successfully. The nurse also plays a critical role in the assessment and management of pain (Elçigil, 2011). Pain management aims to minimize the behavioral and physiological causes, intensity, and duration of pain and provide the highest benefit. It is not

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possible to eliminate pain. However, it is important to reduce the pain enough to relieve the adolescent (Uğurlu et al., 2014).

During the PCR test, adolescents display reactions like crying, screaming, fearful facial expressions and feeling pain. Both the suspicion of illness and the hospital environment may further increase the adolescent's reactions (Beal, 2021; Tuna & Açıkoğuz, 2015). To manage this situation appropriately, nurses should have sufficient experience, knowledge, and skills in the assessment and control of pain and fear (Tuna & Açıkoğuz, 2015).

No studies, to the best of our knowledge, have been conducted to reduce the procedure-induced fear and pain of adolescents giving PCR Tests. Within the scope of the study, stress ball squeezing and relaxation exercise methods were used. In this respect, the study is expected to make a contribution to the literature.

The stress ball, one of the cognitive distraction methods, is a soft object and has an acupressure effect due to the pressure on the palm (Genç et al., 2022). A limited number of studies show that the stress ball is effective in painful and fearful interventions in children (Aykanat Girgin & Göl, 2020; Sadeghi et al., 2013; Shekhar et al., 2022). Relaxation exercises include periods of breathing in, waiting, breathing out, and waiting, and each movement lasts for four seconds. Relaxation exercises are reported to be a highly effective method to alleviate physical symptoms caused by stress (Bahrololoomi et al., 2022) It is recommended to perform relaxation exercises for an average of 10 min for the body to relax again in anxiety states. The effectiveness of distraction to reduce the fear and pain experienced by adolescents have been shown in various studies (Kristjansdottir & Kristjansdottir, 2011; Schneider, 2018; Suresh et al., 2015). Stress ball squeezing and relaxation exercises are also among the distraction methods. Such methods are expected to have high effectiveness and low cost in the first place. It is also thought that relaxation exercises and stress ball squeezing may be advantageous methods in reducing pain and fear considering their easy accessibility, affordable cost, and sustainability. Therefore, this study was conducted to determine the effect of a stress ball and relaxation exercises on the management of PCR test-induced fear and pain.

Method

The population of the study consisted of adolescents aged 12–18 years admitted to X Hospital for PCR tests. The sample size was determined by power analysis using G*Power (v3.1.9) program. The power of the study is expressed as $1 - \beta$ (β = probability of type II error), and studies should generally have 80% power. Power analysis was performed to determine the adequacy of the sample size of the study, and it was determined that the power of the study was 0.95 with a significance level of 0.05, a confidence interval of 0.95, and an effect size of 0.97 (Davas & Kürtüncü, 2021). According to this calculation, 29 people should be assigned to each group. In case of possible case losses, the study was completed with 96 adolescents and their parents, 32 in each group. This randomized trial has been registered (ClinicalTrials.gov Identifier: NCT05250544) (Fig. 1).

Randomization

Adolescents were randomly assigned to the groups. Stratification and block randomization methods were used to assign the participants to the control and intervention groups. Age, gender, and fear of the interventional procedure are among the factors affecting the fear and stress experienced by adolescents during interventional procedures. Accordingly, adolescents were stratified as “boys and girls” for gender variable and “yes/no” for fear of the procedure, and block randomization was applied. The determined strata were created as codes obtained from a permutation-based computer program (<https://www.randomizer.org>). Which letter would be the intervention or control group was determined at the beginning of the study with the closed

opaque envelope method, and the letter A was assigned to the control group, B to the stress ball group, and C to the relaxation exercise group.

Blinding

Participant and statistician blinding were performed in the study. For participant blinding, participants were only informed about their group, and informed consent was obtained. Three different informed consent forms were created for the participants. In addition, adolescents in the sample were prevented from communicating and interacting. For statistician blinding, the group of the data added to the database was expressed only by letters, and the group these letters represented was not shared. As a result of the analysis, the study groups were expressed as A, B, or C, and group assignments were completed according to the letters.

Inclusion criteria for the adolescent; being in the 12–18 age group, getting the PCR tests procedure by the same nurse, having no hearing problems, having the PCR Test in a single try, having no history of epilepsy, migraine, or vestibular disorders, not taking any analgesia in the last six hours, not taking any medication regularly that may affect the feeling of pain and fear, and speaking and understanding Turkish.

Exclusion criteria; adolescents in the stress ball group who could not use the stress ball effectively, and adolescent or parent who wants to withdraw from the study.

Data collection tools

The data were collected using the Adolescent and Parent Information Form, The Children's Fear Scale (CFS), The Wong-Baker Faces Pain Scale (W-BFPS), and stress ball and relaxation exercises.

The Adolescent and Parent Information Form: It is a form prepared by the researcher by consulting an expert and reviewing the literature (Aykanat Girgin & Göl, 2020; Elçigil, 2011; Kristjansdottir & Kristjansdottir, 2011; Sadeghi et al., 2013; Schneider, 2018; Suresh et al., 2015; Tuna & Açıkoğuz, 2015) to obtain information about the adolescents and their parents. The form questions the demographic characteristics of the adolescents and parents, whether the adolescent has any disease and variables that may affect the adolescent's pain and fear levels due to the procedure. Prior to the study, the interview and observation forms were applied to five adolescents and their parents. Necessary revisions were made, and the form was finalized. These adolescents and their parents were excluded from the study.

The Children's Fear Scale (CFS): First used in 2003, the CFS, is a scale developed to assess the child's level of fear and has proven validity and reliability. It is an easy-to-understand scale for patients over the age of five. There are five different facial expressions with no fear at one end of the scale and very intense fear at the other end of the scale, and it is evaluated between 0 and 4 points. 0: no fear, 4: extreme fear (McMurtry et al., 2011).

The Wong-Baker Faces Pain Scale (W-BFPS): It is one of the most frequently used scales to measure pain severity in children. The scale was developed by Donna Lee Wong and Connie Morain Baker in 1981 and revised in 1983. It is used in children aged 3–18 years. It's a self-report pain intensity scale. W-BFPS is safe to use in children older than three years who can verbalize the degree of pain. The scale includes face shapes and numbers. Pain is graded between “0” and “10” points. The level of pain felt is described with increasing degrees of facial expression. Since it is a visual scale, it is suitable for use in all cultures (Wong & Baker, 1988).

Stress Ball: It has a plastic and soft structure that can be held comfortably. Each ball is about 7 cm in length and width and is a soft toy that is squeezed and manipulated with the fingers to relieve stress and muscle tension and exercise the muscles. There is no risk for children (no small pieces that can be put in the mouth). The ball is in different colors like orange, blue and green (Genç et al., 2022). Since all adolescents involved in the study were admitted to the hospital with suspicion of the disease,

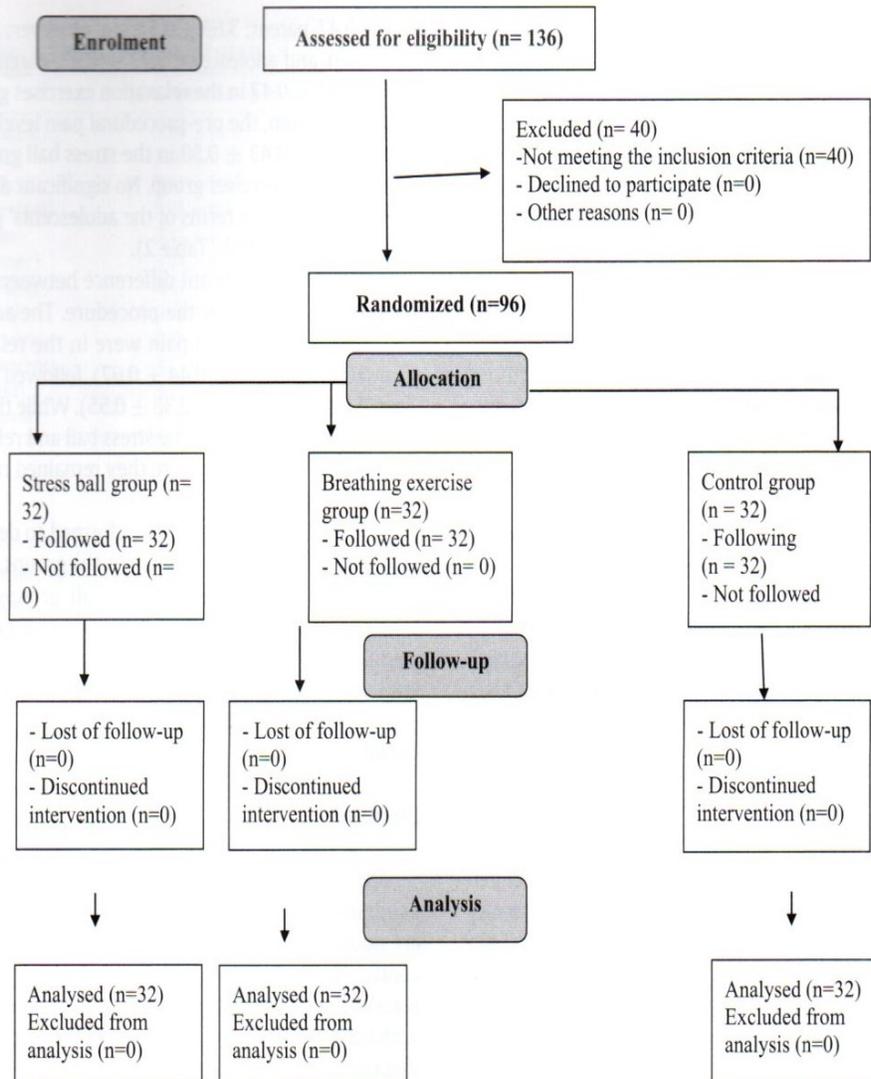


Fig. 1. Consort 2010 diagram of this study.

separate balls were given to all adolescents in the stress ball group to minimize the transmission of the disease, and the balls given were not taken back.

Relaxation Exercises: Relaxation exercises are practiced for about 10 min, mostly to control fear and stress. It has four different steps, and each step period takes an average of four seconds. The steps are inhaling, waiting, exhaling, and waiting (Oakes, 2011) and were practiced as follows:

- Place your right hand on your chest and your left hand on your abdomen.
- Inhale through the nose (silent counting to 4), wait 4 s, and slowly exhale through the mouth (silent counting to 4).
- If your rib cage (right hand) moves during inhalation and exhalation, you are breathing incorrectly.
- While breathing, pay attention to this: When we inhale, our abdomen will swell (the left hand will move), it will remain swollen as long as we hold our breath, and it will move inward when we exhale (Demir & Gündoğan, 2018).

For the adolescent to be able to perform these practices correctly, the researcher gave instructions and allowed him/her to practice for about 10 min. To prevent the risk of contamination during breathing, the exercise was performed in a separate room, and the patient and the researcher wore masks. The room was disinfected after each exercise.

Data collection

The study was conducted in the following order. Before the data collection phase, adolescents and their parents who met the sample selection criteria of the study were informed about the purpose and content of the study, and their verbal and written consent was obtained. Then, the adolescents and their parents were informed by the researcher about the Children’s Fear Scale (CFS) and Wong-Baker Faces Pain Scale (W-BFPS) scales used in the data collection phase. Materials were prepared beforehand (data collection tools, stress ball, stopwatch). Descriptive characteristics were obtained from adolescents and family members and recorded in the interview and observation form. Before the procedure, adolescents self-rated their fear and pain levels using the CFS and W-BFPS scales. In addition, before the procedure, parents and observers also evaluated and scored adolescents’ fear and pain levels with the CFS and W-BFPS scales. After the procedure, adolescents scored their fear and pain levels during the procedure with CFS and W-BFPS. In addition, after the procedure, the parent and observer also observed the behavioral state of the adolescent during the procedure and evaluated and scored the child’s fear and pain level during the procedure with CFS and W-BFPS. To determine the PCR test time in all groups, a stopwatch was used and recorded.

For the adolescents in the control group, a stopwatch was started as soon as the procedure started to determine the duration of the procedure and stopped at the end of the procedure. After the procedure, the adolescent’s fear, and pain related to the procedure were evaluated separately by the adolescent, parent, and observer and recorded on the form.

A stress ball was introduced to the adolescents in the stress ball group, and they were asked to hold the ball of the color they wanted. After explaining how to squeeze the stress ball, the PCR Test was started a few seconds after the adolescent started squeezing. The stopwatch was started as soon as the process started and stopped when the procedure was finished. Then, the adolescent's fear and pain related to the procedure were evaluated separately by the adolescent, parent and observer and recorded on the form.

The relaxation exercises were introduced to the adolescents in the relaxation exercise group, and they were expected to complete the exercises. Immediately after the exercise was completed, the PCR Test was performed with the first deep breath. The stopwatch was started as soon as the procedure started and stopped when the procedure was finished. After the procedure, the adolescent's fear and pain related to the procedure were evaluated separately by the adolescent, parent, and observer and recorded on the form.

Data analysis

Independent groups *t*-test was used for normally distributed binary variables, paired *t*-test was used for intra-group pre-test-post-test evaluation, and Tukey test was performed for ANOVA advanced analysis in the analysis of items with three or more variables.

Ethical procedure

Ethical permission was obtained from X University Faculty of Health Sciences Non-Interventional Ethics Committee, and institutional permission was obtained from the relevant institution. In addition, permissions were obtained via e-mail from the authors of the Turkish validity and reliability of the scale used in the study. The purpose of the study was explained to the adolescents and their families who met the selection criteria for the research group, their questions were answered, and their written consent was obtained.

Results

The mean age was 14.93 ± 2.07 years for the adolescents, 43.58 ± 4.50 years for the mother, and 48.25 ± 4.92 years for the fathers. Adolescents were stratified according to age, gender, and fear of invasive procedures, and homogeneity was ensured in their distribution to the groups. In each group, 46.9% of the adolescents were female (*n* = 15), and 53.1% were male (*n* = 17). The number of hospitalizations of the adolescents in each group ranged from 1 to 4, and there were no adolescents hospitalized due to COVID-19. No adolescent had constant medication, used analgesic drugs in the last six hours, had a disease that could affect pain perception, and all adolescents had very few invasive procedures (1–3 times). The groups showed a similar distribution in terms of all these variables (*p* > 0.05).

The duration of the PCR test was measured in all groups. The average duration of the control group was 6.03 s, while it was 4.69 s in the stress ball and relaxation exercise groups. The difference between the groups showed that the procedure duration in both stress ball and relaxation exercise groups was significantly shorter than in the control group (*p* < 0.001, Table 1).

The pre-procedural level of fear was adolescent: 3.91 ± 0.30, parent: 3.90 ± 0.28, and observer: 3.91 ± 0.29 in the control group, adolescent:

3.81 ± 0.47, parent: 3.69 ± 0.54, and observer: 3.72 ± 0.68 in the stress ball group, and adolescent: 3.72 ± 0.92, parent: 3.81 ± 0.78, and observer: 3.81 ± 0.47 in the relaxation exercises group, which were moderate. In addition, the pre-procedural pain level was 0.41 ± 0.50 in the control group, 0.43 ± 0.50 in the stress ball group, and 0.41 ± 0.50 in the relaxation exercises group. No significant difference was found between the groups in terms of the adolescents' pre-procedural fear and pain scores (*p* > 0.05) (Table 2).

There was a significant difference between the groups in terms of both fear and pain after the procedure. The adolescents who experienced the least fear and pain were in the relaxation exercise group (fear: 0.09 ± 0.29; pain: 0.44 ± 0.67), followed by the stress ball group (fear: 1.94 ± 0.435; pain: 2.38 ± 0.55). While the average of fear scores of the adolescents in both the stress ball and relaxation exercise groups decreased after the procedure they remained more or less the same in the control group (Table 2).

In Tukey's further analysis performed to determine the group that constituted the difference between the groups, it was determined that the difference in scores between all groups was significant (*p* < 0.001). Accordingly, the relaxation exercise group (fear: 0.09 ± 0.29; pain: 0.44 ± 0.67) experienced the least fear and pain at a significant level, followed by the stress ball group (fear: 1.94 ± 0.435; pain: 2.38 ± 0.55) and the control group (fear: 3.91 ± 0.30; pain: 4.13 ± 0.34) (Table 2).

Discussion

The PCR test, which has become widespread with the COVID-19 pandemic, is a very stressful and painful procedure. However, there are no studies on nonpharmacological methods that can be applied to control the pain caused by this test. In our study, the pre-procedural fears of the adolescents in all groups were similar, and they increased with the procedure if no intervention was performed. It was concluded that relaxation exercise was the method that allowed adolescents to experience the least fear and pain. No studies to our knowledge have evaluated the effect of relaxation exercises and stress ball on fear and pain caused by PCR tests. In our study, pre-procedural relaxation exercises reduced fear and pain significantly more than other methods. It can be said that relaxation exercises are an effective method to reduce the fear and pain caused by PCR, which may be because the exercise performed before the procedure relaxes the adolescents and allows them to move away from the procedure more easily.

In this study, adolescents experienced less pain and fear when using the stress balls in the pre-PCR procedure than in the control group. Aydın et al. (2016) applied three different methods (softball squeezing, balloon inflation, and distraction cards) to 120 children to relieve pain and anxiety in phlebotomy procedure and found no difference between the groups in children's own, parent, and observer procedural pain levels in all three methods (*p* = 0.446, *p* = 0.467, *p* = 0.318, respectively). In addition, no significant differences were observed between the groups in child anxiety levels according to parents and observers (*p* = 0.323, *p* = 0.144, respectively). Relief in pain and anxiety was observed in all three methods, but no statistically significant differences were found. Aykanat Girgin and Göl (2020) evaluated and compared the effects of balloon inflation, ball squeezing, and coughing methods on pain and fear levels during venipuncture in children aged 7–12 years in a randomized controlled study. It was found that the mean pain and fear scores of the children in the balloon inflation, ball squeezing, and coughing groups were lower compared to the control group. In a randomized controlled trial conducted by Shekhar et al. (2022), the effects of a stress ball and an active distraction technique with audiovisual goggles on dental anxiety, behavior, and pain levels of children during local anesthesia were compared. It was found that active stress ball distraction or passive use of audiovisual goggles during local anesthesia reduced dental anxiety in children. Considering that stress balls are easy to use and do not require complex skills

Table 1
Mean procedure duration and comparison of groups.

	Min.	Max.	Mean	Std. Deviation	F	p
Control Group	3	9	6.03	1.257	19.319	<0.001
Stress ball group	4	6	4.69	0.738		
Relaxation Exercises Group	3	7	4.69	0.931		

Table 2
Adolescents' pain and fear mean scores and comparison of groups.

	Control Group Mean ± sd	Stress Ball Group	Relaxation Exercises Group	F / p
Pre-procedure Fear (adolescent)	3.91 ± 0.30	3.81 ± 0.47	3.72 ± 0.92	0.725 / 0.487
Pre-procedure Fear (parent)	3.90 ± 0.28	3.69 ± 0.54	3.81 ± 0.78	1.176 / 0.313
Pre-procedure Fear (observer)	3.91 ± 0.29	3.72 ± 0.68	3.81 ± 0.47	1.087 / 0.341
Post-procedure Fear (adolescent)	3.91 ± 0.29	1.94 ± 0.435	0.09 ± 0.29	956.290 < 0.001
Post-procedure Fear (parent)	3.91 ± 0.30	1.94 ± 0.435	0.09 ± 0.29	956.290 < 0.001
Post-procedure Fear (observer)	3.91 ± 0.30	1.94 ± 0.435	0.09 ± 0.29	956.290 < 0.001
Pre-procedure pain (adolescent)	0.41 ± 0.50	0.43 ± 0.50	0.41 ± 0.50	0.042 / 0.959
Pre-procedure pain (parent)	0.41 ± 0.50	0.43 ± 0.50	0.41 ± 0.50	0.042 / 0.959
Pre-procedure pain (observer)	0.41 ± 0.50	0.43 ± 0.50	0.41 ± 0.50	0.042 / 0.959
Post-procedure pain (adolescent)	4.13 ± 0.34	2.38 ± 0.55	0.44 ± 0.67	376.76 < 0.001
Post-procedure pain (parent)	4.13 ± 0.34	2.38 ± 0.55	0.44 ± 0.67	376.76 < 0.001
Post-procedure pain (observer)	4.13 ± 0.34	2.38 ± 0.55	0.44 ± 0.67	376.76 < 0.001

Sd:Standart Deviation.

(Sadeghi et al., 2013), this method could be used effectively by nurses in painful procedures. Another application like the stress ball application is the Su Jok method. Hidalgo (2012) applied the Su Jok method to patients with anxiety and observed a reduction in the anxiety levels of the patients. Based on these results, stress ball application is recommended to be used to reduce pain and fear in the PCR test of adolescents.

The most noteworthy result of this study is that breathing exercises as a relaxation exercise before the PCR procedure was found to be more effective in reducing pain and fear than other methods. There are a limited number of studies using breathing exercises as a relaxation exercise in other painful procedures in children. Bahrololoomi et al. (2022) evaluated the effectiveness of breathing exercises to reduce pain and anxiety in a painful procedure in children aged 7–10 years and noted that breathing exercise is an effective distraction and relaxation method to reduce pain in children aged 7–10 years with moderate to severe anxiety. Abdolizadeh et al. (2018) evaluated the effectiveness of “deep breathing with blowing paper whirligigs” methods in reducing the pain of blood sampling and reported that both methods of distraction in this study (deep breathing with blowing paper whirligigs and deep breathing) can effectively decrease the venipuncture pain. In a randomized controlled study evaluating behavior, anxiety, and pain during buccal infiltration anesthesia in children aged 7–11 years, the effectiveness of “bubble breath exercise” was evaluated, and it was determined that the use of bubble breath exercise was effective in reducing perceived pain during maxillary buccal infiltration anesthesia in children aged 7–11 years (Sridhar et al., 2019). The effectiveness of “external cold and vibration” and “blowing soap bubbles” methods in reducing pain during phlebotomy in children aged 3–6 years was examined and pain scores were found to be lower in the external cold and vibration and blowing soap bubbles groups than the control group, and it was argued that external cold and vibration and soap bubble blowing methods had a pain-relieving effect (Binay et al., 2019). As seen in the literature and the results of this study, it can be concluded that the use of breathing exercises as a relaxation exercise is effective in reducing pain and fear in painful interventions.

Another factor that may affect the mean scores of fears and pain in adolescents is the duration of the procedure. The shorter the procedure, the lower the level of fear and pain will be. In our study, there was a significant difference between the groups in terms of procedure duration. The groups with the shortest procedure duration were the stress ball and relaxation exercise groups. The group with the longest procedure duration was the control group. The comparison of fear levels after the procedure is similar to these durations at some point. Adolescents in the control group had both the longest procedure time and the highest level of fear and pain. However, while there was no significant difference between the procedure duration of the stress balls and relaxation exercise groups, the fear and pain levels of the adolescents in the exercise group were significantly lower. This demonstrates that the exercise group is the most effective method in reducing pain and fear when the duration and other conditions are equalized.

Limitations/strengths

The inability to generalize this study to adolescents of all age groups can be considered a limitation of this study as it was conducted in an adolescent group. Nevertheless, the results of this study provide new information to the literature about the effectiveness of relaxation exercises and stress ball in pain and fear management of adolescents during PCR testing.

Conclusion

It was concluded that relaxation exercise is the most effective method to reduce PCR test-induced fear and pain in adolescents. Other distraction methods such as stress balls may also be effective. Relaxation exercises are an easy and cost-effective intervention. Therefore, it is recommended to be implemented in outpatient settings where PCR testing is performed in Türkiye.

Ethical approval

Ethical approval was obtained from the Karamanoğlu Mehmetbey University Faculty of Health Sciences Non-Invasive Clinical Research Ethics Committee on 29.12.2021 (Document ID: 08–2021/42), and institutional permission was obtained from the hospital.

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CREDIT Statement

Vildan Apaydin Cirik: Conceptualization, Investigation, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Ayşe Sonay Türkmen:** Conceptualization, Investigation, Formal analysis, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Merih Ayaz:** Conceptualization, Investigation, Data curation, Writing – original draft.

Declaration of Competing Interest

No conflict of interest has been declared by the authors.

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