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Non-pharmacological Techniques to Control Pain and Anxiety during Medical Procedures in Children under 15 Years: A Systematic Review

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Abstract

One way to control pain and anxiety in a variety of medical procedures in children is through the use of non-pharmacological distraction techniques. Therefore, the present research aimed to investigate the effectiveness of such techniques.

In this systematic review, PubMed, Scopus, Web of Science, and Google Scholar were searched for articles published between 2015 and 2022 using specific keywords such as distraction, non-pharmacological techniques, procedural therapy, and children. Following the search, a total of 42 original articles and 21 review articles were screened and evaluated for inclusion in the study.

The distribution of medical and therapeutic procedures in the articles reviewed was as follows: 21.4% were related to dentistry, 21.42% to IV procedures, 14.28% to vaccinations, 9.52% to painful interventions, 7.14% to blood sampling, 7.14% to surgeries, 4.76% to stitches, and 14.28% to other procedures. Non-pharmacological solutions mentioned in the articles included robotic technology (14.28%), watching cartoons (11.9%), training videos (7.14%), mother's presence, breastfeeding and mother's voice (7.14%), audio-visual tools (4.76%), music therapy and pressure technique (7.14%) and various other solutions.

Given the lower risk of complications associated with non-pharmacological techniques, the sensitivity of children to drug dosage and side effects, and the cost-effectiveness of these techniques, their use is preferred in pediatric medical procedures.

Keywords: Distraction, Children, Medical procedures, Non-pharmacological technique.

Introduction

Pain is a mental feeling and reaction caused by the perception of nerves in different parts of the body. The body is exposed to internal or external stimuli, and one of the most common symptoms is physical and emotional discomfort such as fear and anxiety (1). Anxiety is in fact one of the most common reactions of children to painful treatment procedures. High levels of anxiety can be harmful to the child's physical and mental health prevent the correct performance of treatment procedures and increase maladaptive behaviors evoking negative emotions about the treatment staff (2,3). Pain and anxiety can lead to physiological changes, such as increased heart rate and breathing, sweating, decreased blood oxygen saturation, pupil dilation, restlessness and high blood pressure. It is also followed by other defense and protective mechanisms in the body that appear in abnormal conditions. Due to the importance of pain and its management, the American Academy of pain has ranked pain as the fifth vital sign to manage (1). Medical procedures are often accompanied by pain, which in turn increases children's anxiety and fear before, during and after the procedure (4). One duty of medical service providers in protecting patient rights is to control and reduce pain, especially in children, and try to relieve it (1). One way to control pain and anxiety during various medical procedures in children is non-pharmacological distraction techniques. There are different types of non-pharmacological distraction techniques, all trying to reduce the feeling of pain and anxiety using psychological techniques to influence physiology (5). Many studies have been conducted on the effect of different non-pharmacological distraction techniques on the level of anxiety and pain in children, including virtual reality (VR), companion health, clowns, storytelling, audio-visual tools, robotics, etc. The effectiveness of each has been investigated in different types of therapeutic procedures (6). The exact mechanism of distraction is still not well understood, yet distraction techniques are believed to affect the patient's attention capacity and can distract the patient's attention from the harmful stimulus (8, 7). Cognitive-affective attention models can correctly explain this phenomenon (9).

Considering the importance of controlling pain and anxiety in children during medical procedures, which can increase their cooperation in the healthcare process and advance care goals, the present study was conducted to test the effect of non-pharmacological distraction methods on the amount of pain and anxiety in children under 15 years during healthcare procedures.

Methods

The current study is a systematic review aimed at investigating non-pharmacological distraction techniques for controlling pain and anxiety in children during medical procedures. The international databases PubMed, Scopus, Web of Science, Science Direct and Google Scholar were searched using keywords such as distraction, pediatric medical procedures, and non-pharmacogical techniques from 2015 to 2024. The Persian equivalents were also searched in national databases Elmnet, Magiran, and SID. The search in these databases was conducted independently by three researchers, with a third person consulted in case of discrepancies. The inclusion criteria were articles that examined non-pharmacological distraction techniques for managing pain and anxiety during medical procedures in children. Short articles, letters to the editor, conference abstracts, and articles without full text were excluded. The studies were then screened based on title and abstract, resulting in 2,200 articles initially retrieved. After removing duplicates and irrelevant items through evaluation of title, abstract, and full text, 42 original articles on non-pharmacological distraction techniques during various medical procedures in children were selected. Figure 1 illustrates the process of searching and selecting the studies in detail.

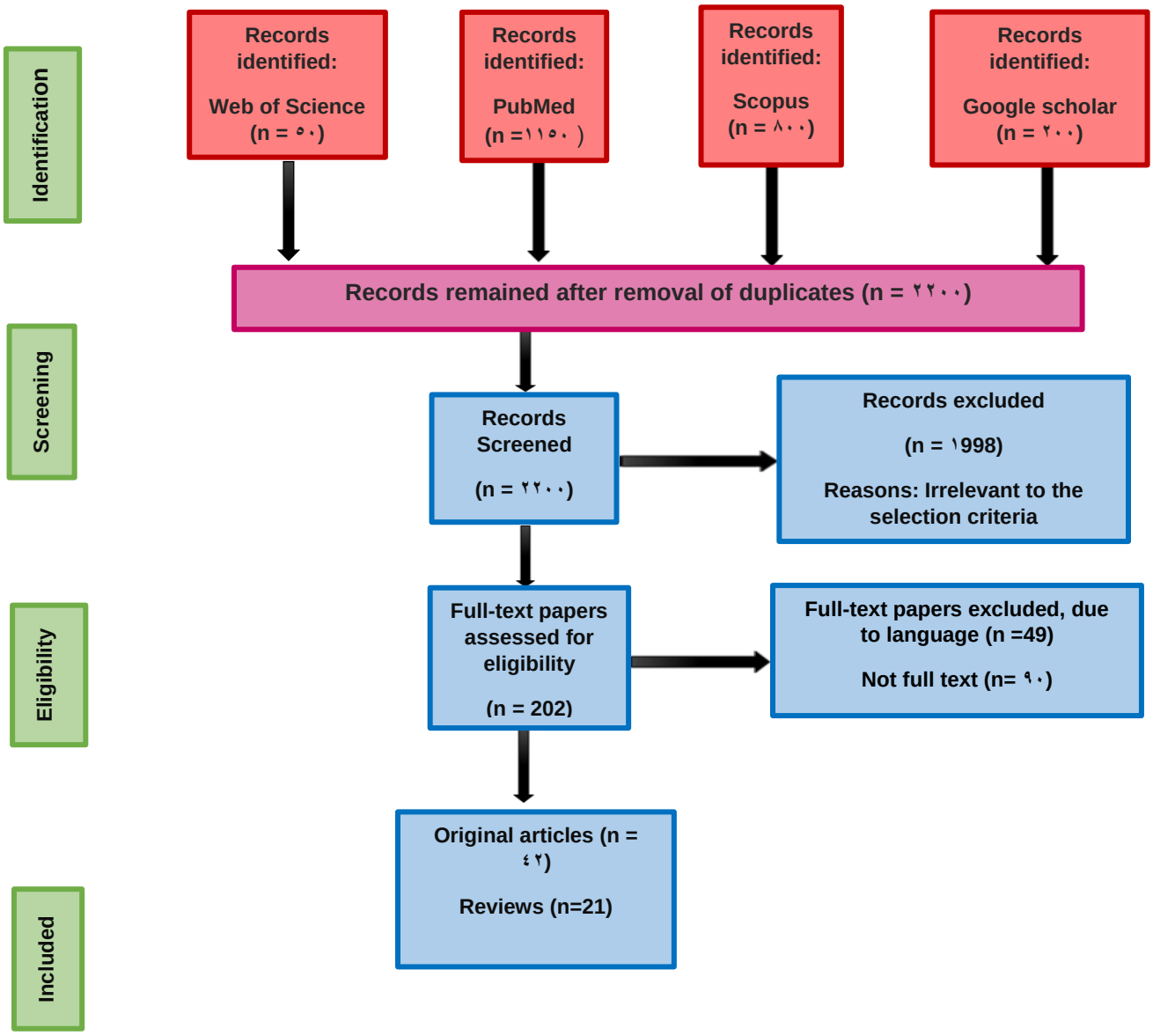

Figure 1. Flowchart of the article selection process for inclusion in the study

Results

The data collected in this research included: first author's name and year of publication, type of medical procedure, type of distraction technique, target population and effect of distraction technique. More details of the articles are presented in Table ١.

Table 1. Details of the reviewed articles in the current research

Row and reference	**First author and publication year**	**Type of medical procedure**	**Type of distraction technique**	**Effect of distraction technique**
١ (10)	P. V. A. Aditya ٢٠٢١	dentistry	Using features, spammers, Kaldiscope and virtual reality	Effective in reducing children's anxiety
٢ (11)	U. B. Dixit and ٢٠٢١	dentistry	Interactive distraction	Cost-effective and effective in managing children's fear and anxiety
٣ (12)	A. Garrocho-Rangel ٢٠١٨	dentistry	Using Vess audiovisual equipment	Lack of favorable effect in controlling pain and anxiety compared to other traditional medicinal methods
٤ (13)	F. Ghaderi ٢٠٢٠	dentistry	Using lavender aromatherapy	Effective in reducing pain and anxiety in children
٥ (14)	S. Ghadimi ٢٠١٨	dentistry	Watching a cartoon	Lack of favorable effect on controlling and reducing anxiety during treatment procedure
٦ (15)	H. Güand ٢٠٢٠	dentistry	Using local heat	Effective in reducing children’s pain during the procedure compared to other medicinal methods
٧ (16)	Y. Kasimoglu ٢٠٢٠	dentistry	Robotic technology	Effective in reducing pain and anxiety in children
٨ (17)	J. Kharouba ٢٠٢٠	dentistry	Watching a cartoon	Effective in reducing children's anxiety and improving social relations and children's behavior during the procedure
٩ (18)	S. Shekhar ٢٠٢٢	dentistry	Stress ball and audio visual glasses	Effective in controlling anxiety during the procedure and not having a favorable effect on pain control

١٠ (19)	B. Aykanat Girgin ٢٠٢٠	blood sampling	Using the method of inflating the balloon and pressing the ball and coughing	The methods of inflating a balloon and pressing the ball are effective in controlling pain and reducing fear and anxiety during the procedure, and the cough solution is less effective than other methods in controlling pain and fear during the procedure.
١١ (20)	Nejla Canbulat Şahiner ٢٠٢٢	Blood sampling	Using a vacuum cleaner with a cartoon design	Effective in reducing pain and anxiety during the procedure
١٢ (21)	Sevil Inal ٢٠٢٠	Blood sampling	Using Buzzy the rmomechanical) (technique	Effective in controlling pain and not having a favorable effect on controlling anxiety during the procedure
١٣ (22)	Tuba Koç Özkan ٢٠٢٠	Getting an IV	Acupressure	Effective in pain control during the procedure
١٤ (23)	Alereza Momenabadi 2021	Getting an IV	Using music therapy and acupressure at the Hugo point	Effective in controlling children's pain in both methods
١٥ (24)	Samina Ali ٢٠٢١	Getting an IV	Using an iPad	Lack of favorable effect in reducing pain and anxiety during the procedure
١٦ (25)	Gabriela S Ortiz ٢٠١٩	Getting an IV	music therapy	Effective in pain control during the procedure
١٧ (26)	Swati Chavan ٢٠٢١	Getting an IV	Watching a cartoon	Effective in pain control during the procedure
١٨ (27)	Sherzad Khudeida Suleman ٢٠٢٢	Getting an IV	Art-based intervention called Children's Office Coloring	Effective in controlling pain and anxiety during the procedure
١٩ (28)	Sacide Yildizeli Topcu ٢٠٢٠	Getting an IV	chewing gum	Effective in pain control during the procedure

٢٠ (29)	Rachelle C W Lee-Krueger ٢٠٢١	Getting an IV	Robotic technology to teach deep breathing as a coping strategy	Lack of favorable effect in reducing pain and anxiety
٢١ (30)	Christine T Chambers ٢٠١٨	vaccination	Pain management training video	Effective for parents to manage children's pain during the procedure by parents
٢٢ (31)	Manal Kassab ٢٠٢٠	vaccination	Using sucrose	Effective in reducing pain during the procedure
٢٣ (32)	Zohreh Karimi ٢٠٢٢	vaccination	Using breastfeeding intervention	Effective in reducing pain during the procedure
٢٤ (33)	Esra Karaca Ciftci ٢٠١٦	vaccination	Using skin irritation	Effective in reducing pain during the procedure. Babies in the intervention group had fewer cats than the control group
٢٥ (34)	Tuğba Güngör ٢٠٢١	vaccination	Using local heat and cold	More effectiveness of local cold compared to local heat in reducing pain before the procedure
٢٦ (35)	Pedro Gorrotxategi Gorrotxategi ٢٠٢٢	vaccination	Breastfeeding in babies aged 2 to 11 months and sounding a party horn by a 4-year-old child	Effective in pain control during the procedure
٢٧ (36)	Samina Ali ٢٠١٨	Getting an IV	Robotic technology	No additional pain and anxiety on children and an effective tool in non-pharmacological distraction during the mentioned procedure
٢٨ (37)	F. Alhani ٢٠١٩	surgery	Using mother's voice as hearing therapy	Effective in reducing children's anxiety after surgery
٢٩ (38)	Doa'a Abdullah Dwairej ٢٠٢٠	surgery	Using video games	Effective in reducing children's anxiety before surgery, during transfer to

				the operating room and after surgery
٣٠ (39)	Francesco Molinaro ٢٠٢٠	surgery	Robotic technology during surgery	Lack of favorable effect on reducing postoperative pain during robotic surgery
٣١ (40)	Marzieh Beigom Bigdeli Shamloo ٢٠١٨	suture	face to face training	Effective in reducing anxiety and pain during the procedure
٣٢ (41)	Hyo Jeong Choi ٢٠٢١	suture	Watching a cartoon	Effective in controlling the pain and anxiety of children aged 3 to 6 years during the procedure
٣٣ (42)	Nejla Canbulat Şahiner ٢٠١٩	Intramuscular injection	Using distraction cards	Effective in controlling pain and anxiety during the procedure
٣٤ (43)	Hülya Durak ٢٠٢١	Therapeutic inhalation in children with acute bronchitis	Watching a cartoon	Effective in controlling children's anxiety and fear during the procedure
٣٥ (44)	Çiğdem.Erdoğan ٢٠٢٠	Painful interventions for children in the intensive care unit	Using mother's voice	Effective in controlling children's pain during and after painful interventions
٣٦ (45)	Christian E Farrier ٢٠١٩	Painful medical interventions for children hospitalized in the ward	Robotic technology using distraction strategies and deep breathing in outpatient and inpatient departments	Effective in controlling anxiety and pain during and before painful interventions
٣٧ (46)	Wendy M Gaultney ٢٠٢١	Painful medical interventions	Using cognitive load theory	Lack of favorable effect in controlling pain and anxiety during the procedure
٣٨ (47)	Emma Rheel ٢٠٢١	Painful medical interventions	Using Pain Neuroscience Education (PNE) technique	Effective in controlling pain during the procedure and increasing the pain tolerance threshold

٣٩ (48)	Claudio Longobardi ٢٠١٩	While waiting for an emergency doctor's examination	Soap bubbles	effective in controlling pain while waiting for a doctor's examination and not having a favorable effect on controlling pain after a doctor's examination and controlling anxiety while waiting and after a doctor's examination
٤٠ (49)	Sarah Kisling ٢٠٢١	People with chronic pain	Educational video about pain awareness	Effective in teaching children how to manage pain and not having a favorable effect on pain control
٤١ (50)	Fatemeh Cheraghi ٢٠٢٠	Changing the burn dressing	Watching a cartoon	Effective in pain control during the procedure
٤٢ (51)	Lindsay A Jibb ٢٠١٨	Subcutaneous injection of children with cancer	Robotic technology aiming to use psychological strategies	Effective in controlling anxiety during the procedure and not having a favorable effect on pain during the procedure

Discussion

The review of 42 original articles and the information summarized in Table 1 revealed that 21.42% of the medical and therapeutic procedures were related to dentistry, 21.42% were related to IV injections, 14.28% to vaccinations, 9.52% to painful interventions, 7.14% to blood sampling, 7.14% to surgeries, 4.76% to suturing, and the remaining 14.28% were related to inhalation therapy, intramuscular injection (IM), chronic pain, burn dressing change, and subcutaneous (SC) injection. Among these distraction techniques, 14.28% involved with robotic technology. Half of these techniques were effective in controlling pain and anxiety, while the other half were not effective. 11.9% of the techniques involved watching cartoons, with 80% of them being effective in controlling pain and anxiety, and the remaining 20% not being effective. 7.14% of the techniques included pain management training videos, which can be considered an effective solution for teaching pain management, but in 33.3% of cases, there was no favorable effect on control. Additionally, 7.14% of the reviewed articles mentioned the presence of the mother, breastfeeding by the mother, and the use of the mother's voice as effective ways to control pain and anxiety. 4.76% of the techniques were related to audio-visual tools, with the Vess audio-visual device not affecting pain and anxiety control during the procedure, and audio-visual glasses only affecting anxiety control. Furthermore, in 7.14% of studies mentioned music therapy and pressure techniques as solutions to control pain and anxiety. Other

effective methods included face-to-face training, video games, soccer balls, chewing gum, inflating balloons, pressing balls, coughing, and using an iPad as an ineffective distraction solution to control pain and anxiety during medical procedures. Overall, in 75.47% of procedures, non-pharmacological distraction strategies, significantly helped control pain and anxiety during the procedure, while in the remaining 24.53% of procedures no favorable effect was observed.

To explore other non-pharmacological distraction techniques during various types of medical procedures, additional articles were reviewed, each offering a solution to reduce the feeling of pain and anxiety in children.

Music therapy

Music plays a significant role in our daily lives, evoking various feelings and emotions. The human brain has remarkable ability to receive and process music, with the auditory system, brain lobes, and Wernicke's area responsible for analyzing it. The primary areas receive signals from the inner ear while the perception of music, including pitch frequency, melodic contours and volume, is processed through the thalamus and primary areas. Secondary areas handle complex patterns of harmony, melody, and rhythm, with tertiary areas allowing for a deeper understanding of music (17). Furthermore, music processing not only activates other brain regions, but also impacts mesolimbic dopaminergic pathways, leading to enhanced anxiolytic effects (43).

Audio-visual tools

Audio-visual tools, such as screens and headphones that cover the eyes and ears, are considered modern distraction tools. They provide both sound and image simultaneously, creating a three-dimensional environment for the viewer and listener (19). This application may be more appealing to children than other traditional methods discussed in this review. It causes disconnection from the real world during the medical procedure (16). A study suggested that the use of audio-visual tools is an effective yet costly way to reduce feelings of pain and anxiety during dental procedures, making them suitable for adults as well (19).

The clown

Humor has long been recognized as one of the most effective factors for coping with stressful life, situations and has always been a focus of researchers. Among all the areas and aspects of human life influenced by humor, pain control has consistently captured the interest of researchers. Humor is seen as a factor that is linked to behavioral resistance to pain (9). In a study, humor was presented as a viable solution, similar to other distraction techniques, for reducing anxiety and pain in children (17).

Mobile health

Mobile health is a new field of health-care that can increase people's ability to self-care (11). Today, people in around the world use mobile phones more than ever before. For example, in America, 82% of the population used smartphones in 2018 (23). In Finland, 94% of people under the age of 55 had a smartphone (17). Smartphone devices, programs and games can be used as a distraction approach for children to reduce their pain and anxiety (32).

Play Therapy

Play therapy is a simple, affordable, and readily available intervention that has been used for years to reduce stress and anxiety in children during medical procedures (6). WHO introduced the right to play as one of children's rights in medical centers and hospitals, encouraging doctors and nurses to incorporate games into treatment procedures (14). In a limited review study, Gjaerde et al. investigated the effect of games on the levels of anxiety and pain in children during hospital procedures. The evidence in the study showed that interventions and play therapy had a positive impact on the four clinical areas of education, diagnostic processes, treatment and recovery, and adaptation,

ultimately reducing feelings of pain and anxiety (52).

Cold and shivering

The Buzzy device is designed to provide cold and vibration simultaneously, effectively reducing pain at the injection site. It is an easy-to-use, reusable and quick method of non-pharmacological distraction. This device resembles a bee, with two components: the bee's body (vibration) and the bee's fins (cold). The combined application of vibration and cold affects pain receptors and the body's nervous path ways, reducing the sensation of pain (33). However, various studies have yeild different results. In a study by Faghihian et al., which examined the impact of vibration on pain level through a systematic review, the vibration intervention was not found to be an effective method of non-pharmacological pain distraction with no significant difference between the intervention and control groups. No review studies were identified either (53).

Virtual reality

Virtual Reality (VR) has been increasingly used in recent years as a new, non-pharmacological method for medical procedures (14). VR devices create a sense of distraction that can help reduce pain and anxiety in various medical procedures such as dentistry (18), burns, wound care, and venous access (24). The side effects of using VR in medical procedures are minimal compared to other distraction methods. Only with long-term use can symptoms like dizziness, headache, nausea and eye pressure increase (32).

Conclusion

The current research review was conducted to explore different techniques or distraction and pain reduction during therapeutic procedures in children. Through a thorough investigation, it was found that various non-pharmacological distraction techniques can be highly effective in managing pain and anxiety during medical procedures. These techniques have fewer side effects compared to pharmacological methods, are cost-effective, and are highly effective. Due to children's high sensitivity to dosage and side effects, it is recommended to use non-pharmacological distraction techniques in therapeutic and medical procedures.

Conflict of interest

The authors have confirmed that this study has no relevant financial or non-financial competing interests.

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