

Non-pharmaceutical Approaches for Pediatric Pain Management: Review of Literature

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Abstract

Background: Nonpharmacological management as an alternative approach to reducing pain intensity among children has recently been widely tested in experimental studies. Many types of nonpharmacological pain management were investigated at different medical invasive procedures. Therefore, it's difficult to determine which approach is more effective for pain reduction among children. That is why this review is made.

Objectives: The current review aims to introduce an evidence base on pain management among children, through an evaluation and critique for the most evidence-based researches world-wide that applying the nonpharmacological approaches only.

Methods: A narrative review study focused on pediatric nonpharmacological pain management studies, that carried out by searching the available databases such as Google Scholar, Research Gate, Semantic Scholar, and PubMed. The included studies were available free for download and were published for the last ten years. All selected studies were looking for the effect of nonpharmacological pain management among the pediatric population. 15 studies were selected according to study criteria out of 640 available studies. These studies were recorded by forming a data extraction form in a Microsoft Excel sheet to include authors name, year of publication, targeted sample, study design, methods of nonpharmacological pain management, and main findings of the study and recommendation.

Results: Fifteen studies met the inclusion criteria, all studies include one type or more methods of nonpharmacological pain management for children, that tested the effect of such approaches on pain level. The non-pharmacological pain management approaches are approved to be as effective as and occasionally better than the pharmacological pain management approaches.

Conclusion: This review highlights that adopting the nonpharmacological pain management approaches is effective and may be better than the pharmacological approaches in reducing the associated pain during medical procedures. This review draws a step for further research for new and creative approaches to decrease children's pain and increase their compliance during painful medical procedures.

Keywords: non-pharmacological pain management, pediatric pain or children's pain, review of literature.

أساليب تدابير الألم غير الدوائية للأطفال : مراجعة الأدبيات

خلفية البحث: بشكل كبير تم اختبار تدابير الألم غير الدوائية كنهج بديل لتقليل شدة الألم بين الأطفال في الدراسات التجريبية مؤخرًا. تم اختبار العديد من طرق تدابير الألم غير الدوائية في إجراءات طبية مختلفة. لذلك ، من الصعب تحديد النهج الأكثر فاعلية للحد من الألم بين الأطفال. وهو الغرض من إجراء هذا المراجعة.

الغرض: تهدف المراجعة الحالية إلى تقديم أدلة تستند إلى دليل حول تدابير الألم بين الأطفال من خلال تقييم ونقد أغلب البحوث القائمة على الدليل عالميا والتي اعتمدت الأساليب غير الدوائية فقط .

المنهجية: دراسة مراجعة الادبيات السرديّة حول الدراسات التي تركز على تدابير الألم للأطفال ، اجريت عن طريق البحث في قواعد

البيانات المتاحة مثل Google scholar و Research Gate و Semantic Scholar و PubMed . الدراسات المتضمنة في البحث كانت متاحة للتنزيل مجانا وتم نشرها على مدار السنوات العشر الماضية. سعت جميع الدراسات المختارة إلى إيجاد تأثير تدابير الألم غير الدوائية بين الأطفال. تم اختيار 15 دراسة وفقا لمعايير الدراسة من أصل 640 دراسة متاحة. تم تسجيل هذه الدراسات عن طريق عمل نموذج من Microsoft Excel sheet ليتضمن اسم الباحث ، سنة النشر ، العينة ، تصميم البحث ، طرق تدابير الألم ، النتائج ، و توصيات البحث.

النتائج: استوفت 15 دراسة معايير المطلوبة للدراسة الحالية ، وتشمل جميع الدراسات نوعا واحدا أو أكثر من طرق تدابير الألم غير الدوائية للأطفال ، والتي اختبرت تأثير هذه الأساليب على مستوى الألم. تبين ان طرق تدابير الألم غير الدوائية كانت فاعلة وأحيانا أفضل من طرق الألم الدوائي.

الاستنتاجات: تسلط الضوء هذه المراجعة على اعتماد طرق و تدابير الألم غير الدوائية فعالة وقد تكون أفضل من الأساليب الدوائية في تقليل الألم المصاحب أثناء الإجراءات الطبية. ترسم هذه المراجعة خطوة لمزيد من البحث عن طرق جديدة ومبتكرة لتقليل آلام الأطفال وزيادة امتثالهم أثناء الإجراءات الطبية المؤلمة.

الكلمات المفتاحية: تدابير الام غير الدوائية ، ألم الاطفال ، مراجعة الادبيات

Introduction:

Pain is a stressful event that can be experienced by adults and children during their lives, It can effect on their physical and psychosocial well-being (Bajjali, 2019). The data from pediatric hospitals around the world showed pain is widespread, underdiagnosed, and undertreated in pediatric patients from infancy to puberty (Linhares et al., 2012). Children may exposed to at least five painful medical procedures every day during the period of hospitalization (Bergman et al., 2022). Children with serious medical disorders are subjected to unpleasant diagnostic and therapeutic procedures. Furthermore, even healthy children endure a substantial number of painful medical operations throughout their childhood such as vaccinations (Hohmeister et al., 2010; Linhares et al.,2012).

In hospitals, children frequently experience traumatic events and episodes of pain, mostly associated with negative emotional and psychological consequences (Tufekci et al., 2017). Children who are exposed to extreme pain experience without sufficient pain management documents, higher rates of morbidity and mortality. Both nonpharmacological and pharmacological pain management can be used to manage pain episodes among adults and children. Traditionally, analgesics were used mostly and effectively to reduce pain intensity. However, depending on these medications can cause serious side effects for patients and increase the economic burden (Karabulut, 2016).

In addition, the tolerance to analgesics and medication can develop among children as adults, over time, the effectiveness of analgesics can decrease, and either the dosage needs to be increased significantly or the available medical products may need to be changed (Gaire & Prasai, 2020). Research indicated, that early childhood pain can lead to long-term changes in how people perceive pain and behave in response to it, it can lead to poor cognitive and motor function, chronic pain in adulthood, anxiety, and depressive disorders (Srouji et al., 2010).

Sometimes children only experience mild pain for which pharmaceutical treatment is not required, in this situation, choosing an alternative method is required (Geziry et al., 2018). To manage pain in children, non-pharmacological methods can be used, which make up a significant percentage of pediatric medical care. It is commonly recognized to be an alternative strategy employed either alone or in conjunction with medication (Çelebioğlu et al., 2015). In most cases, the non-pharmacological method

has been successful and is widely accepted around the world. Several non-pharmacological methods are effective in reducing the perception of pain in cooperating children (Tufekci F. et al. 2017).

The non-pharmacological approaches mainly can include cognitive-behavioral therapy, physical therapy, emotional support, providing a supportive environment, and assistance with daily life activities. (Efe et al., 2017; Seldon, 2017; Gélinas et. al., 2013). It aims to reduce fear, and anxiety, relieve pain, and provide comfort, without including the administration of pain drugs. In addition to the advantages of being inexpensive, easy to apply, and safe (Geziry et al., 2018; Dimitriou et al. 2017).

However, its effectiveness depends on pain intensity, the child`s cooperation and belief, the type of methods and timing when used, and parents' involvement (Gan et al. 2014). Nonpharmacological pain management techniques are approved effective for managing mild and moderate pain level among children (Chlan & Halm. 2013). The review of the literature revealed that using distracting methods such as watching cartoons during painful procedures is effective in reducing pain levels among young children (Dovney & Zun, 2012).

Applying of virtual reality for painful procedures has recently expanded significantly (Dumoulin et al. 2019; Al-Halabi et al. 2018). The therapeutic game also helps older children understand medical procedures, and using medical equipment on the doll before any treatment showed a reduction in the level of pain (Short et al. 2017; Deshpande & Shah, 2019). A specific emotional adjustment can be supported by music therapy. music therapy can reduce pain intensity and duration of analgesics (Gélinas et al., 2013). The spiritual intervention by using Quran recitation as an adjunctive therapy, can produce a relaxation response and stabilize newborns` vital signs during invasive procedures (Marofi et al., 2018).

Simple relaxation therapy involves the use of deep breathing techniques to promote and induce calm. Blowing bubbles is a diversionary technique that involves the visual sense. Children who underwent this technique were able to distract themselves since they had to concentrate on the breathing process (Acuna, 2019). Moreover, massage can be used for stimulating the skin and surrounding tissues with various hand angles and pressure to reduce discomfort, relax, and/or increase blood flow (Seldon, 2017).

In children, it is more challenging to assess pain properly because of their developmental and cognitive levels, communication skills, and experiences from previous pain. (Srouji et al., 2010; Linhares et al., 2012). Bayoumi et. al. (2021) stated nurses face challenges in assessing children`s pain levels due to children`s developmental and cognitive levels, and depend on their experience. Inadequate pain management can increase the level of stress and anxiety for the child and their parents, cost of treatment, prolonged hospitalization, and decrease desired health outcomes (Ung et al. 2016). Moreover, it impacts on child`s quality of sleep, mobility, irritability, and anxiety levels (Purity & Bunmi, 2014).

Eliminating pain and suffering when it can be is a vital role of healthcare providers who look after children, frequently, nurses are vital in the assessment and management of a child's discomfort (Mohamed et al.,2021; Acuna, 2019). Nurses at pediatric hospitals need to be encouraged to apply nonpharmacological pain management approaches. Therefore, this review aims to review the evidence base approaches that based on nonpharmacological pain management to reduce children`s pain, that could improve their compliance during medical procedures and prevent psychosocial trauma.

METHODS

Research design

A narrative review study was conducted between 20th April to 10th July, 2023 to determine the effect of nonpharmacological pain management methods on the reduction of children's pain levels. Including studies that use different methods to decrease children's pain without using analgesics, and find their effectiveness on children's pain levels .

Search Methodology

The strategies of searching started with looking for studies published during the last 10 years on the available databases: Google Scholar, Research Gate, Semantic Scholar, Science Direct, and PubMed. The keywords used for searching include "non-pharmacological pain management", "nursing management of pain", "non-drug pain management", and pediatric pain or children's pain .

Inclusion and exclusion

The review included studies published at least 10 years ago. The studies included applying one or more than one method of nonpharmacological pain management, all candidate studies targeted children. All included studies depend on clinical control trials, and experimental and quasi-experimental design to find the effect of the used methods.

Screening articles

Studies went through two steps of screening by the researchers, The first step quick review of both the title and abstract, to decide whether or not the study meets the inclusion criteria, and the second step includes further screening for the entire article for final decision.

Data extraction

After the selection of articles, data was extracted and recorded by forming a data extraction form in a Microsoft Excel sheet. The domains included in the data extraction form were country and year of publication, targeted sample and sample size, study design, methods of nonpharmacological pain management used in the study, outcome measures, and main findings .

RESULT

Of a total of 640 studies retrieved from the targeted websites, about 275 studies were excluded and 215 of the remaining were duplicated, 15 out of 120 studies were chosen, and the others were neglected either for the language barrier, not using the English version, or for including mix sample of medical and nonmedical field, (table, 1)

Table (1): A Description of the Previous Studies on Pediatric Pain Management

Author's	Method of pain management	Design	Sample	Findings	Recommendation
Suleman et al. (2024)	compare trace image colors, cough trick, and balloon inflation methods on child's pain level and fear during the venipuncture procedure.	randomized control trail. The Wong Baker Pain Rating Scale and Children's Fear Scale was used.	(160) school children were randomly assigned into four groups to assess the effect of each used methods.	the trace image colors, followed by cough trick, balloon inflation were effective to reduce child pain and anxiety of children.	apply these distractive methods to reduce pain and fear among children during venipuncture procedure.
Yu et al. (2023)	Compare between the pharmacological (EMLA) and non-pharmacological management (distraction) effect to reduce pain during venipuncture procedure	A randomized clinical trial. The Wong Baker Pain Rating Scale and FLACC scale were used to evaluate child pain. salivary cortisol levels, heart rate, and oxygen saturation to measure child responses.	A total of (299) child between 3-16 years old, assigned in three groups to find the effectiveness of the used methods.	The all the used pain management methods were effective in reduce children pain and fear levels. no statistical difference in pain levels among the three groups	applied others appropriate intervention to reduce pain of children.
Atak and Özyazıcıoğlu (2021)	Compare the effect of three means for anxiety and pain management (audio distractions) the audiobooks, Turkish music, and classical music	quazi-experimental study. The Wong Baker Faces Pain Scale, State Trait Anxiety Inventory Scale, and Visual Analog Scale were used to asses children pain and anxiety levels	(90) children undergone surgery, were divided to three groups	the three audio distraction means were effectively reduced pain and anxiety level among children.	Using classic music as a mean to decrease pain of children undergo surgery.

				listening to classical music was the most effective one	
Karamisefat et al. (2021)	The effect of foot massage on child pain during venipuncture procedures.	clinical trial. By using FLACC scale the pain level of children was used.	(70) preschoolers were distributed in two groups equally.	significant differences in pain level between control and experimental groups after two minutes of invasive procedure	depend foot massage for reducing pain intensity and promote child experience with some invasive procedures
Patil et al. (2021) of	Compare the effect of three types of local anesthesia and the vibrating device on pain levels of children during dental procedures	Clinical trial study. Wong Baker facial pain scale, and FLACC scale were used to assess children pain level.	(60) children within age 6 - 12 years, were they divided into four groups.	Children group with vibrator devices showed low level of pain than children with 3 types of local anesthesia.	Applying vibrating device effective to reduce pain of children during dental procedures
Shoghi et al. (2021) group.	Find the effect of mothers' voice on children pain level and physiological parameters, during blood sampling.	single blind randomized clinical trial. COMFORT pain scale, and monitoring devices were used to collect the data.	(50) children in PICUs randomly assigned into two groups equally.	The mean score of pain and heart rate in children in the intervene group was lower than control one.	Using mothers' recorded voice as a mean to reduce pain intensity of children during invasive procedures.
Bulut et al. (2020)	Compare three non pharmacological pain methods, music therapy, hand massage, and	randomized control experimental study. FLACC pain scale was used.	140 male child, 7-14 years, divided into four groups, undergo circumcision	a significant difference in pain level between the	depend on music and kaleidoscopes technique for reducing pain among children

	kaleidoscope to reduce pain intensity.		operation.	intervene and control groups	
Erdoğan et al. (2020)	exam the mothers` sound on pediatric pain intensity during painful procedures	randomize control trail. FLACC pain scale and physiological parameters of the participants were measured.	(60) children within age 1-3 years, assigned into two groups equally.	A significant difference between the both groups regarding their Pain level, heart rates, and oxygen saturation.	Count on mothers` sounds as an easy option to decrease children pain, especially during invasive procedures.
Olsen et al. (2019)	Compare the effect of different distraction methods (conventional, music, film, and storytelling) on children pain after operation	case-control study, by using the Wong-Baker Faces Pain Scale.	(241) child within age 2-7 years, distributed to five groups.	the children in the intervene group showed lower degree of pain level than control group	use distraction technique for children postoperatively to reduce their pain level.
Longobardi et al., (2019)	Applying soap bubbles method to reduce children pain level in emergency room.	A parallel trial study. The self report pain was used to assess child pain degree.	(74) children assigned into experimental and control groups.	a significant difference between pain level of both groups before experience medical procedure only	apply soap bubble method to reduce child pain
Nunna et al. (2019)	Effect of virtual reality and counter-stimulation on children pain and anxiety during dental procedure	Randomized single-blinded clinical trial. The Wong Baker faces pain scale, visual analog scale, and Venham's clinical anxiety scale (VCARS) were used to assess children responses.	(70) children within age 7–11 years old, distributed in two groups	Children of virtual reality group showed a low level of pain and anxiety than counter simulation group	Applied VR distraction method to reduce children pain and anxiety during invasive procedures

Walther-Larsen et al . (2019)	Effect of virtual reality games on children satisfaction, pain during IV cannulation procedures	randomized clinical trial. Children pain assessed by visual analog scale.	(64) children aged 7-16 years, they were assigned to the control group	A high level of satisfaction among children. While no significant difference between the pain scores of both groups..	VR can applied to achieve children satisfaction, find alternative method to reduce children pain.
Marofi et al. (2018)	evaluate neonates responses during heel stick procedure, by exam the effect of Holy Quran sound	Clinical trial. The physiological parameters and neonate pain scale used	(72) full-term neonates at NICU. divided into two intervene and a control groups.	The physiological parameters record were lower in the intervene group in comparison before and after the procedure	apply Holy Quran sound during neonates painful procedures.
<u>Gerçeker</u> et al. 2018	effects of three methods: the virtual reality, external cold and vibration methods on children pain scores during phlebotomy	A randomized controlled study. The self-report, parent's reports, and Wong Baker scale were used.	(121) children aged 7-12 years, allocated in three groups.	All the used methods were effective in pain reduction among children.	Apply virtual reality method as a safe pain management of children who growing up in technology
Miladinia et al. (2016)	Effect of non speech music therapy to decrease children pain postoperatively.	A quasi-experimental study. Children pain level was scored by Numerical Rating Scale	(63) children were divided into intervene and control groups.	the pain level of both groups was not significantly different	Find another alternative non pharmacological methods to decrease child pain level.

The included studies were categorized into the following thematic review.

Different Methods of non-pharmacological Pain Management for Children

From the review of the 15 studies, a conclusion can be drawn as three main nonpharmacological approaches are commonly used for children in different age groups and variant medical procedures. The common nonpharmacological pain approaches varied their duration of application, frequency, and time of application. They commonly depend on distraction methods for children's attention span ability. Some studies compare more than one method's efficacy, while others compare their efficacy with the pharmacological methods. Most of these studies depend on child self-reporting to evaluate their pain levels.

Pharmacological and non-pharmacological pain management methods

Two studies out of the included studies compared the effect of pharmacological the nonpharmacological pain management among children during invasive procedures. Patil et al. (2021) in their clinical study aimed to compare the effect of 3 types of local anesthesia and vibrating devices, on the pain levels of sixty children between ages 6 - 12 years, during injection of local anesthesia for dental procedures, that they divided into four groups. Wong Baker's facial pain rating scale and FLACC scale were used to assess children's pain levels. Their results demonstrated that the children group with vibrator devices showed a lower level of pain than children in EMLA gel, and lignocaine gel groups .

In that line, the comparison between the pharmacological and non-pharmacological management in a randomized clinical trial by Yu et al. (2023), to reduce pain among children during venipuncture procedure. A total of (299) children between the ages of 3 to 16 years were assigned to three groups. The first group intervened by EMLA, the second with distraction intervention, and the third group by combination methods. The Wong-Baker Pain Rating Scale and FLACC scale were used to evaluate child pain. The salivary cortisol levels, heart rate, and oxygen saturation were used to measure child responses during the IV cannulation procedure. The finding revealed, that all the used interventions were effective in reducing children's pain levels and fear, and the statistics showed no statistical difference in pain levels and responses among the three groups. The recommendation of the study was focused on applying other appropriate interventions to reduce the pain of children.

Distraction methods in children pain management

Distraction methods are the most common type of nonpharmacological pain management used for children at various medical procedures. Due to the ability of children to attention span, this method can transfer the immediate unpleasant idea about a specific situation to another happier idea and distract pain temporarily. Seven studies included different methods of distraction techniques, such as vibration devices, soap bubbles, kaleidoscope, and balloon inflation.

A parallel trial study was conducted by (Longobardi et al., 2019), to determine the effect of the soap bubbles method on reducing children's pain, anxiety, and fear of children in the emergency room. A (74) children were assigned randomly into experimental and control groups. The self-report pain was used to assess the child's pain degree. Children in the control group scored their pain level at two points, before and during the application of the medical procedure. Their result recorded a significant difference between the pain levels of both groups before children experienced the medical procedure, while after the procedure the data showed no differences between them. The result also showed no differences between the groups concerning anxiety levels. The researchers recommended applying this method to reduce child pain.

The vibration device is also used to distract children from pain associated with painful procedures. Patil et al. (2021) used the vibrating device to reduce children's pain levels, (60) children between the ages of 6 - 12 years participated during injections for dental procedures. Wong Baker's facial pain rating scale and FLACC scale were used to assess children's pain levels. The results

demonstrated that the children group with vibrator devices showed a lower level of pain than children in EMLA gel, and lignocaine gel groups. In another study, Gerçeker et al. (2018) examined the vibration device on the pain level of (121) children between the age of 7-12 years during Phlebotomy. Their finding revealed, that children's pain scores were decreased. A Kaleidoscope device also was used to decrease the pain level of male children with age 7-11 years old. undergo circumcision operation. The finding revealed a significant difference in pain levels between the intervention and control groups $P < .05$. the researchers advised depending on the kaleidoscope technique for children (Bulut et al., 2020).

Suleman et al. (2024) compare the effect of trace image colors and balloon inflation methods on a child's pain level and fear during the venipuncture procedure. (160) School children participated in a randomized control trial. The Wong-Baker Pain Rating Scale and Children's Fear Scale were used to assess pain levels and fear among children. Their finding reported the pain and fear levels of children in the intervention groups were significantly different than the control group, the result showed the order of the effectiveness on pain and fear levels was for trace image colors first, followed by balloon inflation. The authors recommend applying distractive methods to reduce pain and fear among children during venipuncture procedures.

Music therapy in children pain management

Music was used for long-standing to increase the feeling of relaxation and comfort, using of music was adopted to decrease the effect of associated pain and anxiety for adults and children during some painful procedures, some studies approved its effects while others did not.

Postoperatively, music was examined in a quasi-experimental study by Miladinia et al. (2016). With a participant of (63) children were divided into intervention and control groups. A nonspeech music was used for about twenty minutes for the intervention group only. Children's pain level was scored on the Numerical Rating Scale, for five trials, before, immediately, after one hour, three hours, and six hours of the music intervention respectively. Their result reported the pain level of both groups was not significantly different at $P > 0.05$. Atak and Özyazıcıoğlu (2021), also find the impact of two types of music, classic and Turkish music on children's pain and anxiety levels postoperatively. The participants of 90 children underwent surgery at a pediatric hospital. The authors utilized three pain scales, Wong-Baker Faces Pain Scale, State-Trait Anxiety Inventory Scale, and the Visual Analog Scale, to assess children's pain and anxiety degree. Their result showed the two types of music effectively reduced pain and anxiety levels among children, however, listening to classical music was the most effective one.

To compare the effect of music with other distracting methods, Olsen et al. (2019) in Denmark, examined the distraction technique in a case-control study. The study included 241 children, between age 2-7 years, they were randomly distributed to study and control groups. The researchers compare music, film, and storytelling methods to reduce children's pain after operation in the Post-Anesthesia Care Unit, the methods were repeated after 15 minutes postoperatively, for three trials consequently. According to their result, the children in the intervention group showed a lower degree of pain level than the control group. The researchers recommended using distraction techniques for children postoperatively.

During the circumcision procedure, the music method was used to investigate male children's pain, fear, and stress undergo, in a randomized control experimental study by Bulut et al., (2020). The authors used music therapy during the circumcision procedure. The finding revealed a significant difference in pain, fear, and anxiety levels between the intervention and control groups.

Sound distraction in children pain management

Some favorable sounds were used to decrease the level of pain in invasive procedures. These sounds distract children from the pain process and make children feel better. In the NICU, Marofi et al. (2018) examined the sound of the Holy Quran on (72) full-term neonates' pain levels during the

heel stick procedure. They were divided into two intervention and control groups, their physiological parameters and neonate pain scale was used to evaluate neonates' responses during the invasive procedure. The result of the study reported that neonates' respiratory and heart rates, and oxygen saturation records were lower in the intervention group in comparison before and after the procedure. The authors recommend applying the Holy Quran sound during neonates' painful procedures.

Sounds of mothers were tested by Erdoğan et al. (2020) in their randomized control trial on pediatric pain intensity during painful procedures in PICU. A sample of (60) pediatrics, within ages 1-3 years were selected randomly, and assigned into two groups equally. Only the intervention group was exposed to their mother's sound during the painful procedure. The finding showed a significant difference between both groups regarding their Pain level, heart rates, and oxygen saturation. The researchers recommended mothers' sounds as an easy option to decrease children's pain, especially during invasive procedures.

Shoghi et al. (2021), also examined the effect of mothers' voices on children's pain level and their physiological parameters during blood sampling. A participant of (50) children in PICUs was randomly assigned into two groups equally. The child's pain level and physiological parameters were measured before and during blood sampling. The result of the study showed, that the mean score of children's pain during blood sampling of both groups recorded a significant difference, the group of children who listened to their mother's voice had lower pain score and heart rate, and higher SpO₂ than the control group.

The sound of the cough trick was tested during the venipuncture procedure, this method was examined on (160) school children, who were randomly assigned into two groups. Children's pain level and fear were assessed by the Wong-Baker Pain Rating Scale and Children's Fear Scale. Their finding reported the pain and fear levels of children in the intervention groups were significantly different than the control group, the result showed cough trick can reduce children's pain and fear levels (Suleman et al., 2024). The sounds of audiobooks applied to children to reduce their pain levels, in a quasi-experimental study by Atak and Özyazıcıoğlu (2021) postoperatively. The author's results showed that audiobook distraction was effective in reducing pain levels among children.

Virtual reality in children's pain management

Recently the technology was applied during painful procedures on children to reduce their pain and increase compliance. Gerçeker et al. (2018) in their randomized control trial, examined the effects of virtual reality on the pain level of children between age 7-12 years during Phlebotomy. Their finding revealed the pain score level of children in the intervention group was lower than control group. Nunna et al. (2019) approve of the significant effect of VR on children's pain and anxiety levels during dental procedures, the authors compare VR with the counter-stimulation effect during local anesthesia. A randomized clinical trial was used on (70) children within 7–11 years. Their study showed VR was better at reducing children's pain and anxiety levels than counter-simulation methods.

On the other hand, some studies did not find the virtual reality method as a means to decrease children's pain. A randomized clinical trial by Walther-Larsen et al. (2019), to determine the effect of VR on children's pain and satisfaction levels during cannulation procedures. (64) children aged 7-16 years, were enrolled into study and control groups during IV cannulation. Children of the intervention group were distracted by the interactive virtual reality game. The study found children were highly satisfied with VR interactive games. While there was no significant difference in children's pain scores of both groups.

Massage in children pain management

Karamisefat et al., (2021) in their clinical trial in Iran, evaluated the effect of foot massage on the pain level of (70) preschoolers during a venipuncture procedure at a pediatric hospital. The sample was selected randomly and then divided into two groups equally, experimental and control groups.

By using the pediatric FLACC scale the researchers assess children's pain level, after applying foot massage for about five minutes for the experimental group only. The researchers assessed the pain degree two times, the first immediately after the venipuncture procedure and the second after two minutes of the procedure. In addition, to measuring children's heart and pulse rate, and oxygen saturation. Their result showed significant differences between the two groups after two minutes of procedure at $P < 0.001$. the researchers recommended nurses at hospitals depend on this method for reducing pain intensity and promoting child experience with some invasive procedures.

Another randomized control experimental study was conducted, to investigate using of the different non-pharmacological methods to reduce male children's pain, fear, and stress undergo a circumcision operation. The authors used music therapy, hand massage, and kaleidoscope, for the children with age 7-11 years old. The sample for the study included 140 children, they were randomly divided into four groups as equals, each group received one type of intervention, except one group as control without intervention. The finding revealed a significant difference in pain, fear, and anxiety levels between the intervention and control groups $P < .05$. the researchers advised depending on music and kaleidoscope techniques for children (Bulut et al., 2020).

DISCUSSION

The current study focus on nonpharmacological pain management for children, and how its effect on children's pain levels at different age groups during various invasive medical procedures. The methods included various interventions without analgesic, these methods depend on visual, audio, physical, and behavioral distraction, and all of these methods were applied at different settings, time required, numbers of participants, tools, and materials used. Each of the nonpharmacological methods has its advantages and disadvantages, and each method has its suitable and proper environment.

Fifteen studies out of 640 studies met the inclusion criteria and were reviewed, all targets of the studies were children from neonate to adolescent period, the included studies were published at the last 10 years ago, and aimed to decrease children's pain during various medical procedures.

The overall look of the study result indicates that the used methods without analgesics were approved for their effectiveness in reducing pain and associated fear and anxiety during painful procedures. Most distraction methods that rely on children's senses successfully decrease pain for children, on the other hand, little showed no differences in pain levels. Some studies compare the efficacy of pharmacological with nonpharmacological methods and prove their effectiveness similar to analgesics.

In recent years, huge attention drawn toward adopting nonpharmacological techniques to reduce children's pain levels, it has been recognized as the mainstream in a healthcare setting by various healthcare providers, the use of the nonpharmacological method and its effect on pain, fear, and anxiety associated with invasive procedures. The most effective methods used as a non-pharmacological pain management for children. The auditory and visual distraction techniques were more effective than the olfactory sense technique. The most common effective distraction techniques were play, music, cartoon watching, and bubbling methods. The use of non-pharmacological interventions was effective equally to using pharmacological pain management (Acuña, 2019).

As technology advances, communities change and develop, and drug tolerance may rise, it's become important to keep up to satisfy the needs, as children tend to prefer technology, interactive, and enjoyable methods to decrease their pain and increase their compliance, for example using virtual reality in medical procedures gives children feel of comfort without idea of fear from harm or being harmed. despite limitations determined in the previous studies, the technique of distraction was effective in reducing children's pain and distress. However, visual distraction was mostly effective among children (Cho & Choi, 2021). it is impossible to predict or determine the amount of pain a person would experience following any procedure. Thereby, to determine which techniques are effective for managing pain in pediatric patients, documentation is required. Parental and child expectations had a good impact, as both parents and children were satisfied with the quality of pain

care offered, despite the child being reported to be in significant pain. Parents were usually pleased with the nurse's pain management (Twycross, 2014).

To sum up, with what was previously narrated, it's been clear how nonpharmacological methods approved their effectiveness in reducing children's pain and taking the position of pharmacological pain methods.

Implication and limitation

This review draws a step for further research, for adopting new and creative nonpharmacological pain management approaches for children. Pharmacological pain management approaches involve physical, psychological, and financial burdens, so it considered to be limiting in their effectiveness, especially in low-resource health settings. This review paper highlights the importance of providing alternative options and recognizing the shortcomings gained from applying the pharmacological approaches only. The researcher believed the alternative promising option could be applied safely and effectively replacing the pharmacological approaches.

This review includes some limitations, the most of the reviewed articles were achieved in developed countries, where the health care providers and children's guardians were aware of using such methods and showed cooperation. Most of the studies were achieved under invasive procedures, IV cannulation, and blood sampling procedures, so the result may not fully represent other painful medical procedures.

Conclusion

This study highlights the fact that adopting the nonpharmacological pain management approaches for reducing pain intensity among children is effective, and may be better than the pharmacological approaches in terms of pain reduction. However, children's pain management depends mostly on distracting methods.

The most advisable nonpharmacological pain management methods for children, when it integrated with modern technology such virtual reality and electronic games for older children. In spite, mothers` voice still recorded as a significant method for pain reduction among young children. Generally, children still need the psychosocial support from their family for exceeding painful trauma. It becomes glaring that, the need for continuously applying nonpharmacological pain management is beneficial .

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Conflict of interest

There is no conflict of interest related to the study

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