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Non-Pharmacological Interventions for Pain Relief during Childhood Vaccination: An Integrative Review

Intervenções não farmacológicas para o alívio da dor durante a vacinação infantil: uma revisão integrativa

Intervenciones no farmacológicas para el alivio del dolor durante la vacunación infantil: revisión integrativa

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Abstract: Objective: To identify in recent scientific literature the methods and devices used to reduce pain and discomfort during childhood vaccination. Method: The study followed the PRISMA 2020 guidelines. Searches were conducted in the SciELO, PubMed, and Web of Science databases, including studies published between 2019 and 2025. Results: Of the 1,546 studies initially identified, 14 met the eligibility criteria. The studies reported that non-pharmacological strategies such as breastfeeding, non-nutritive sucking, sweet solutions, virtual reality, cold and vibration devices, distraction techniques, maternal singing, and videos showed potential in reducing pain, fear, and anxiety scores. However, variability in effect magnitude and methodological limitations were observed in part of the sample, requiring caution in the generalization of the results. Conclusion: The evidence suggests that interventions are safe, accessible, and promote a more positive vaccination experience, contributing to greater family adherence and addressing vaccine hesitancy.
Keywords: vaccination; child; pain management; virtual reality.

Resumo: Objetivo: Identificar na literatura científica recente os métodos e dispositivos utilizados para reduzir a dor e o desconforto durante a vacinação infantil. Método: O estudo seguiu as diretrizes PRISMA 2020. Foram realizadas buscas nas bases SciELO, PubMed e Web of Science, incluindo estudos publicados entre 2019 e 2025. Resultados: Dos 1546 estudos inicialmente identificados, 14 atenderam aos critérios de elegibilidade. Os estudos incluídos relataram que estratégias não farmacológicas como amamentação, sucção não nutritiva, soluções adocicadas, realidade virtual, dispositivos de frio e vibração, técnicas de distração, cantoria materna e vídeos apresentaram potencial na redução dos escores de dor, medo e ansiedade. Observou-se, contudo, variabilidade na magnitude dos efeitos e limitações metodológicas em parte da amostra, o que demanda cautela na generalização dos resultados. Conclusão: As evidências sugerem que intervenções são seguras, acessíveis e favorecem uma experiência vacinal mais positiva, contribuindo para maior adesão das famílias e para o enfrentamento da hesitação vacinal.
Palavras-chave: vacinação; criança; manejo da dor; realidade virtual.

Resumen: Objetivo: Identificar en la literatura científica reciente los métodos y dispositivos utilizados para reducir el dolor y el malestar durante la vacunación infantil. Método: El estudio siguió las directrices PRISMA 2020. Se realizaron búsquedas en las bases de datos SciELO, PubMed y Web of Science, incluyendo estudios publicados entre 2019 y 2025. Resultados: De los 1546 estudios identificados inicialmente, 14 cumplieron con los criterios de elegibilidad. Los estudios incluidos reportan que las estrategias no farmacológicas como la lactancia materna, la succión no nutritiva, las soluciones azucaradas, la realidad virtual, los dispositivos de frío y vibración, las técnicas de distracción, el canto materno y los videos presentaron potencial para reducir las puntuaciones de dolor, miedo y ansiedad. Sin embargo, se observó variabilidad en la magnitud de los efectos y limitaciones metodológicas en parte de la muestra, lo que exige cautela en la generalización de los resultados. Conclusión: Las evidencias sugieren que las intervenciones son seguras, accesibles y favorecen una experiencia de vacunación más positiva, contribuyendo a una mayor adherencia familiar y hacer frente a la reticencia a la vacunación.
Palabras clave: vacunación; niño; manejo del dolor; realidad virtual.

Introduction

Immunization plays a central role in Primary Health Care (PHC), being recognized as a fundamental right and one of the most effective public health promotion strategies. Vaccines are essential not only for prevention but also for controlling infectious disease outbreaks, contributing decisively to global health security and the fight against antimicrobial resistance. Considered one of public health's most successful interventions, immunization saves between 3.5 and 5 million lives per year, preventing diseases such as diphtheria, tetanus, pertussis, influenza, and measles. [1]

In the Brazilian context, the National Immunization Program (PNI) is recognized as an international reference, standing out for its structure, scope, and universal coverage. Since its creation, the PNI has significantly expanded the free availability of immunobiologicals for different age groups and risk groups, strengthening equity in health access and consolidating itself as a pillar of primary care in the Unified Health System (SUS). [2]

Despite these advances, a concerning decline in vaccination coverage has been observed in recent decades, both in Brazil and in other countries. World Health Organization [3] data indicate that in 2022, approximately 25 million children worldwide missed at least one dose of essential vaccines, compromising global efforts to control vaccine-preventable diseases. In Brazil, the VacinaBR [4] Yearbook points to a systematic reduction in adherence to childhood calendar vaccines between 2015 and 2023, with no vaccine reaching coverage targets in all states in 2023.

Among the factors contributing to this scenario, vaccine hesitancy stands out as a growing challenge. Characterized by refusal, delay, or doubt regarding vaccination, it is driven by issues such as fear of adverse events, misinformation, lack of professional qualification, undue contraindications, and the influence of social networks and peer groups. [5] Pain at the time of vaccine administration and local adverse effects, such as swelling and redness, also represent significant barriers to vaccine adherence, directly affecting coverage rates and, consequently, collective immunity. The discomfort experienced by children and their caregivers during the procedure may reinforce vaccine hesitancy and contribute to the spread of preventable diseases. Despite technological advances, virtually all vaccines, with the exception of the oral rotavirus vaccine, still rely on needle-based administration. [5, 6]

Pain associated with injectable vaccines is recognized as one of the main causes of vaccination resistance and is reported as a concern by up to 40 % of parents. [7] In this context, continuous training of healthcare professionals becomes essential so that they are able to recognize, prevent, and manage both pain and anxiety related to the procedure. A welcoming and humanized approach not only improves the users' experience but also promotes adherence to vaccination schedules and may help reframe previous negative experiences, strengthening the bond between families and healthcare services. [8]

Strategies such as providing a welcoming environment, ensuring clear communication about vaccines, and using pain relief devices and methods have been shown to be effective in minimizing discomfort and making the vaccination experience more positive for children and their caregivers. These measures directly contribute to increased adherence and reduced vaccine hesitancy. [8]

The persistence of pain as a central element of the childhood vaccination experience represents a significant challenge for healthcare services, especially in the current context of declining vaccination coverage and increasing vaccine hesitancy. Painful experiences during childhood may trigger anxiety, stress, and avoidance behaviors in future vaccinations, in addition to influencing parents' perceptions

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of the vaccination process. Studies indicate that fear related to injections and vaccination pain may contribute to vaccine delay or hesitancy, particularly when associated with previous negative experiences and the absence of adequate pain management strategies. In this context, interventions aimed at promoting greater comfort and reducing children's suffering become essential to improve the vaccination experience and encourage adherence to immunization programs. [9]

Although several non-pharmacological interventions have the potential to minimize pain and make the procedure more humanized, there remains a gap in the systematization of these strategies and in their regular application in clinical practice. Therefore, conducting this integrative review is justified, as it seeks to synthesize the available knowledge, identify effective methods, and support the implementation of evidence-based practices capable of improving the quality of care, strengthening the bond with users, and contributing to the expansion of vaccination coverage.

In this context, the present study aims to identify, through the scientific literature, the available evidence on methods and devices used to reduce pain and discomfort during childhood vaccination, considering their impact on the user experience and adherence to vaccines.

Method

This is an integrative review study conducted in accordance with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020), [10] aiming to identify scientific evidence regarding the use of methods and devices intended to reduce pain and discomfort during childhood vaccination.

To develop the guiding research question, the PICo strategy was adopted, considering: "P" (population) – children undergoing vaccination; "I" (intervention) – the use of methods and devices to reduce pain and discomfort during the vaccination procedure; and "Co" (context) – vaccination in healthcare services. Based on this strategy, the following guiding question was formulated:

The following research question was formulated: "Which methods and devices have been used to reduce pain and discomfort related to childhood vaccination, and what benefits do these interventions provide during the vaccination procedure?" In this study, benefits were understood as outcomes related to the reduction of pain, fear, anxiety, stress, and childhood discomfort, all of which were considered components associated with the same construct of a positive vaccination experience.

The search for studies was conducted in the SciELO, PubMed, and Web of Science (WoS) databases between August 5 and 27, 2025, as these platforms are widely recognized for their relevance and broad coverage in indexing health-related research. The search strategy combined the Boolean operator "AND" with the Health Sciences Descriptors (DeCS), as presented in Table 1.

Table 1

Search strategy for scientific articles

Database	Search strategy
PubMed	("vaccination") AND ("child") AND ("pain management") ("vaccination") AND ("child") AND ("pain") ("vaccination") AND ("child") AND ("technology") ("vaccination") AND ("child") AND ("pain management") AND ("virtual reality")
SciELO	vaccination and child and pain vaccination and child and intervention vaccination and child and technology vaccination and child and virtual reality
Web of Science	("vaccination") AND ("child") AND ("pain management") AND ("technology") ("vaccination") AND ("child") AND ("pain management") AND ("intervention") ("vaccination") AND ("child") AND ("pain management") AND ("virtual reality")

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Studies published between 2019 and 2025 in Portuguese, English, and Spanish were included if they addressed methods, devices, or strategies used to reduce pain, fear, anxiety, and discomfort during childhood vaccination. Studies with different methodological designs were considered eligible, including intervention, qualitative, cross-sectional, and cohort studies, provided they contributed to the understanding of the effectiveness, applicability, or perception of the strategies used in the vaccination context.

The inclusion of different methodological designs was justified due to the complexity and multifactorial nature of the painful and emotional experience related to childhood vaccination, allowing for a more comprehensive analysis of the strategies employed and their impacts on care.

The following studies were excluded: (a) those published before 2019; (b) those not freely available in full text; and (c) those published in scientific event proceedings or presented as undergraduate final papers, reviews, dissertations, or theses.

The selection of studies was carried out independently by two reviewers, with any disagreements resolved through consensus, following three successive stages: title reading, abstract screening, and full-text reading of the studies. To assist in this process, the Rayyan software was used, a digital tool developed to support systematic and scoping reviews by enabling reference organization, duplicate identification, and independent and blinded screening of studies among reviewers.

The methodological quality assessment of the 14 included studies was conducted using the Joanna Briggs Institute (JBI) tools, [11] according to each study design. Most of the evidence (n = 9) presented a low risk of bias, especially the randomized clinical trials published between 2024 and 2025. Five studies were classified as presenting a moderate risk of bias, mainly due to limitations inherent to non-pharmacological interventions, such as the impossibility of blinding participants and providers in physical distraction and virtual reality techniques.

Results

Initially, the search was conducted using the descriptors and their combinations, employing Boolean operators in the selected databases. After applying the publication year filter (2019–2025), 1,546 potential studies were identified. Subsequently, 92 duplicate articles were excluded with the assistance of the Rayyan software.

During the title screening stage, 1,409 studies were excluded for not meeting the previously established eligibility criteria; therefore, 45 articles remained for abstract reading. After this stage, 30 studies were excluded, two due to the unavailability of the full text and 28 because they included a pediatric population incompatible with the defined eligibility criteria.

The reasons for exclusion at each stage of the selection process are presented in detail in Figure 1, according to the flowchart recommended by the PRISMA guidelines.

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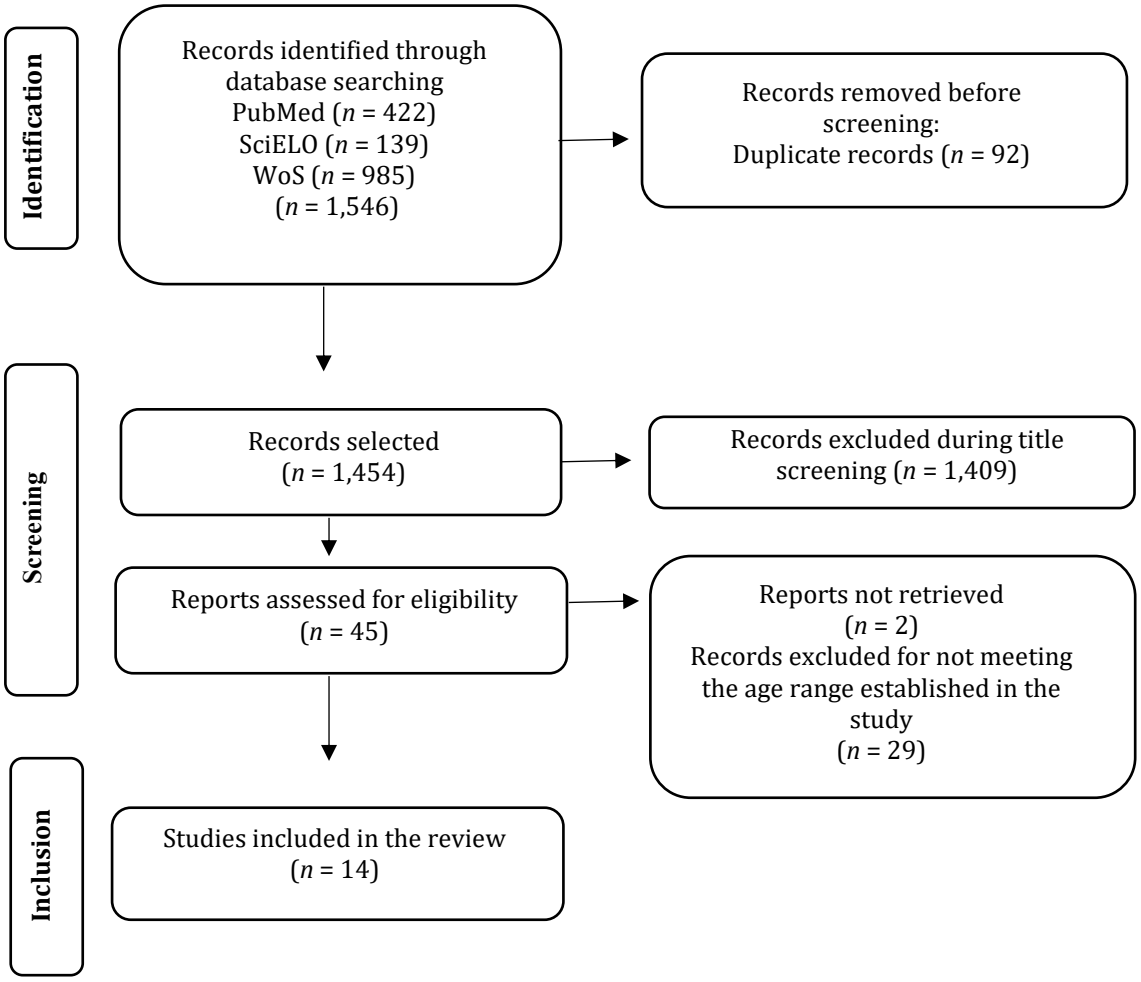


Figure 1. Study selection process.

Data extraction was conducted using a structured model that included the following variables: authors and year of publication, study population, methodological design, and main results. The information obtained was organized in an electronic spreadsheet and analyzed qualitatively based on a thematic approach, which made it possible to identify the methods and devices used to reduce pain and discomfort during childhood vaccination. The synthesis of the selected studies is presented in Table 2.

Table 2

Synthesis of the selected studies

Authors and year	Objectives	Target population	Methodology	Main results and measures of association
Taddio et al. 2022 [9]	To evaluate the perceptions of children and parents regarding a new online game based on the CARD model (Comfort, Ask, Relax, Distract), which teaches coping strategies for pain and needle-related fear.	Fifteen child–parent dyads, with children aged 6 to 12 years.	Qualitative study with a convenience sample; children played the game on mobile devices while being virtually monitored. Follow-up of the activity revealed that most children interacted with multiple components of the game.	After using the CARD game, 60 % of children reported a reduction in needle fear. Both children and parents considered the intervention acceptable and reported an intention to use it in future vaccinations.
Garcia et al. 2019 [12]	To evaluate three non-pharmacological interventions in childhood vaccination: non-nutritive sucking (NNS), breastfeeding (BF), and 50 % glucose solution (GS50) for reducing pain associated with vaccination.	Infants aged 2, 4, and 6 months (a total of 387 children) who received 2, 3, and 1 vaccine(s), respectively, according to the vaccination schedule.	Prospective, non-randomized, non-blinded cohort study; interventions: • NNS using a pacifier; • Breastfeeding during vaccination; • 2 mL of 50 % glucose solution + NNS. Pain was measured using the LLANTO scale and crying time.	Breastfed infants showed lower pain scores at 2 and 6 months and shorter crying duration at 6 months compared to the NNS and 50 % glucose groups ($p < 0.05$).
Sapçi, Kocamaz & Gungormus 2021 [13]	To evaluate the effectiveness of external cold application and vibration (Buzzy® device) in reducing pain, fear, and anxiety in children during vaccination. .	Ninety first-grade elementary school students scheduled to receive a booster dose of the DTaP-IPV vaccine during the school immunization period; 45 in the experimental group and 45 in the control group.	Randomized experimental clinical trial; in the experimental group, the Buzzy® device was applied at the injection site for 30 seconds before vaccination and maintained during vaccine administration; in the control group, no additional intervention was performed; the same nurse administered the vaccines in both groups.	The experimental group showed lower levels of pain and childhood anxiety ($p < 0.05$) with the application of external cold and vibration; however, there was no difference in children's fear levels ($p > 0.05$).
Althumairi et al. 2021 [14]	To evaluate the effectiveness of virtual reality (VR) in reducing pain and fear in children during vaccination.	A total of 104 children aged 4 to 6 years receiving routine vaccination: 53 in the VR group and 50 in the non-VR group.	Cross-sectional study conducted in a primary healthcare unit in the eastern region of Saudi Arabia; compared vaccination with VR-based distraction versus usual vaccination without VR; used the Wong-Baker Faces Pain Scale and the Children's Fear Scale for self-report assessment.	The virtual reality group presented lower pain and fear scores compared to the non-VR group ($p < 0.001$).
Jenkins et al. 2021 [15]	To evaluate the feasibility and acceptability of two innovative devices—Coolsense (cold application) and Buzzy (vibration ± cooling pad)—compared with standard care for minimizing pain during immunizations in children.	Forty children aged 3, 5, and 6 years attending an Immunization Centre at the Royal Children's Hospital in Melbourne, Australia.	Randomized, open-label pilot clinical trial with 1:1:1:1 allocation into four groups: (i) Coolsense + standard care; (ii) Buzzy with cooling + standard care; (iii) Buzzy without cooling + standard care; (iv) standard care (bubble distraction).	Higher adherence was observed in the Coolsense (82 %) and Buzzy® (70 %) groups compared to standard care (60 %). Buzzy® with cooling was considered effective by 70 % of parents.
Chang et al. 2022 [16]	To evaluate the feasibility and effectiveness of immersive virtual reality (VR) in reducing pain and anxiety in children during vaccination in primary care settings.	Thirty children aged 4 to 10 years, accompanied by their parents, attending a public primary care clinic in Singapore. Fifteen children in the intervention group and 15 in the control group.	Randomized clinical trial with an intervention group (VR) and a control group (no VR). Pain was assessed using the Faces Pain Scale–Revised, childhood anxiety using the Children's Fear Scale, and anxiety among parents and nurses using a Visual Analog Scale. Comparisons were performed using the Mann–Whitney U test and the Wilcoxon test.	The intervention group showed a significant reduction in Clinical Frailty Scale scores and parental VAS compared to the control group ($p = 0.04$). Virtual reality was positively evaluated by nurses regarding simplicity, acceptability, and intention for future use ($p \leq 0.02$).
Gorrotxategi et al. 2022 [17]	To evaluate the perceptions of parents and healthcare professionals regarding the use of non-pharmacological measures to reduce pain during childhood vaccination.	Parents and healthcare professionals involved in childhood vaccination.	Multicenter, quasi-experimental interventional study. Intervention group: infants were breastfed, and 4-year-old children used a party horn during vaccination. Control group: vaccination performed according to routine practice.	Lower pain scores were observed in the intervention group among infants ($p < 0.001$) and 4-year-old children ($p = 0.042$). Parents also reported a lower perception of pain ($p < 0.001$).

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Teles & Junior 2022 [18]	To evaluate whether behavioral distraction procedures reduce perceived pain and indicators of anxiety in children during vaccination.	A total of 104 children aged 3 to 12 years attending a Health Center in the Federal District.	The children were divided into four groups (control, balloons, cards, and tablets); a sociodemographic questionnaire, the Monica's Gang Pain Scale, and the Observational Scale of Distress Behavior were used; analysis was performed using SPSS Statistics.	The results showed that the intervention groups presented lower mean pain levels, lower incidence of concomitant behaviors, and shorter duration of vaccination procedures compared to the control group.
Dilek et al. 2024 [19]	To compare the effectiveness of virtual reality and a kaleidoscope as distraction methods in reducing pain, fear, and anxiety during routine vaccination in 48-month-old children.	A total of 126 children aged 48 months receiving the measles-mumps-rubella (MMR) vaccine.	Randomized clinical trial with three groups: virtual reality (n = 42), kaleidoscope (n = 42), and control (n = 42). Pain was assessed using the Wong-Baker Faces Pain Rating Scale, fear using the Children's Fear Scale, and anxiety using the Child Anxiety Scale–State Version. Assessments were performed before and after vaccination.	Post-vaccination levels of pain, fear, and anxiety were significantly lower in the kaleidoscope group compared with the virtual reality and control groups ($p < 0.05$).
Monaci et al. 2024 [20]	To evaluate the effects of maternal singing on reducing pain and increasing mother–infant bonding during routine vaccination in 2-month-old infants.	Sixty-seven mother–infant dyads with infants aged 2 to 4 months, attending Health Centers in the Aosta region, Italy.	Randomized clinical trial with two groups: intervention (maternal singing) and control (standard vaccination). Pain was assessed using the Modified Behavioral Pain Scale, and mother–infant closeness was evaluated through video recordings.	Regarding pain assessment, infants in the maternal singing group showed significantly lower movement scores ($p = 0.032$) and marginally lower crying scores ($p = 0.076$).
Düzkaya et al. 2024 [21]	To compare the effectiveness of Helfer skin tapping technique and the application of the Buzzy® device in reducing pain and fear in children during measles, mumps, and rubella (MMR) vaccination.	Ninety-six 4-year-old children who received the MMR vaccine.	Randomized clinical trial with three groups: Helfer skin tapping technique (n = 32), Buzzy® device application (n = 32), and control group (n = 32). Pain and fear were assessed through observations by parents and nurses, as well as the children's self-reports.	Both the application of the Buzzy® device and Helfer skin tapping technique had beneficial effects in reducing pain and fear during childhood vaccination. However, the Buzzy® device was more effective.
Herrera et al. 2025 [22]	To evaluate the reduction of pain and anxiety after the administration of two vaccines in children aged 3 to 6 years using virtual reality, compared with standard care.	Three hundred children aged 3 to 6 years, randomly assigned to two groups: intervention and control.	Multicenter, open-label, parallel, controlled randomized clinical trial. Intervention group (use of virtual reality goggles) and control group (standard care). Pain and anxiety were assessed using validated scales; heart rate was monitored, and caregiver satisfaction was recorded.	Children vaccinated with immersive virtual reality showed a higher absence of pain (49.3 % vs. 21.3 %) and lower perception of severe pain (0.7 % vs. 12 %) compared with the control group, with a statistically significant difference between groups ($p < 0.001$).
López et al. 2025 [23]	To evaluate the effect of immersive virtual reality on pain and fear perception in children during vaccination, as well as parental satisfaction with the procedure.	A total of 160 children attending the Tres Forques Health Center, randomly assigned to two groups: intervention group (n = 82) and control group (n = 80).	Randomized clinical trial. The intervention group used immersive virtual reality distraction during vaccination, while the control group received standard distraction techniques. Pain was assessed using the Wong-Baker Faces Scale, fear using the Children's Fear Scale, and parental satisfaction was measured through post-procedure questionnaires. Statistical tests such as Student's t-test and the Mann–Whitney U test were used for data analysis.	The intervention group showed lower levels of pain and fear compared to the control group, as well as higher parental satisfaction.
Li et al. 2025 [24]	To explore whether watching cartoons can reduce pain experienced by children during vaccination.	A total of 72 children aged 1 to 6 years participated in the study.	Randomized clinical trial; Cartoon group: watched a preferred cartoon video on a tablet for 10 minutes before and during vaccination; control group: tablet turned on with a blank screen for the same period (10 minutes before and during). Vaccinations were video-recorded, and pain intensity was measured using the Face, Legs, Activity, Cry, Consolability (FLACC) scale, based on observable behavior.	Children who watched cartoons showed lower FLACC scores compared to the control group ($p < 0.001$).

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The 14 studies included in this review [9, 12-24] were published between 2019 and 2025 and addressed non-pharmacological interventions aimed at reducing pain, fear, and anxiety during childhood vaccination. The investigations involved infants, preschoolers, and school-aged children ranging from 2 months to 12 years of age, and explored strategies such as breastfeeding, non-nutritive sucking, sweet solutions, vibration, cold application, virtual reality, digital games, behavioral distraction techniques, maternal singing, as well as visual and audiovisual stimuli.

Most of the studies were randomized clinical trials, followed by quasi-experimental studies, prospective cohort studies, and one qualitative study. Outcome measurements were performed using recognized and validated pain scales, including the Face, Legs, Activity, Cry, Consolability (FLACC) scale, the Wong-Baker Faces Pain Rating Scale, the Modified Behavioral Pain Scale, as well as scales for assessing children's fear and anxiety.

The findings converged toward a significant reduction in pain and discomfort in children when distraction and comfort strategies were used. In infants, methods such as breastfeeding during vaccination and non-nutritive sucking showed positive effects. [12] Among older children, interventions combining cold and vibration, such as the Buzzy® device, consistently demonstrated pain reduction. [13, 15, 21]

Virtual reality, present across different study designs, emerged as one of the most promising techniques, reducing pain, fear, and anxiety compared with standard care. [14, 16, 22, 23] Other behavioral interventions, such as the use of balloons, cards, tablets, or games based on the CARD model, were also effective in reducing fear and promoting greater child engagement. [9, 18] Simple and low-cost resources, such as kaleidoscopes, [19] maternal singing, [20] and cartoon videos, [24] were likewise effective, reinforcing the importance of accessible strategies within healthcare services.

Overall, the analyzed studies demonstrate that non-pharmacological methods are effective, safe, and feasible interventions to reduce pain, fear, and anxiety during childhood vaccination, regardless of age group or care setting. The diversity of identified devices and techniques—ranging from advanced technological resources, such as virtual reality, to simple and low-cost approaches, such as maternal singing and videos—highlight the potential for adapting strategies to different healthcare realities, contributing to an improved vaccination experience and potentially promoting greater adherence to immunization programs.

Discussion

This integrative review sought to synthesize the most recent evidence on the methods and devices used to reduce pain and discomfort during childhood vaccination. The findings confirm the relevance of non-pharmacological strategies in improving care quality and promoting positive experiences during the procedure. [7, 24] The results converge on the understanding that the painful experience associated with vaccination is one of the main factors contributing to needle fear and, consequently, to vaccine hesitancy, a growing phenomenon in several countries. [9] Thus, interventions that make the procedure less aversive have a direct impact not only at the time of vaccine administration but also on the future behavior of children and their caregivers, promoting adherence to vaccination schedules.

Affective-Behavioral and Bonding Strategies

Among the identified interventions, affective-behavioral strategies stood out, characterized by providing emotional support, distraction, and comfort during the vaccination procedure.

In infants, strategies such as breastfeeding, skin-to-skin contact, and non-nutritive sucking remain among the most recommended and result in a consistent reduction in crying and pain scores. [12] These practices are aligned with international recommendations and reinforce the importance of parental participation during the vaccination procedure.

In addition, behavioral distraction interventions, including colorful images, digital games, maternal singing, and preferred videos, also demonstrated effectiveness. The simplicity, low cost, and high acceptability of these methods make them accessible options, especially in resource-limited settings such as primary healthcare units. [18, 19, 20, 23] The findings reinforce that playful and supportive

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strategies can significantly contribute to making vaccination less traumatic for children and their families.

Interventions with Devices and Technologies

Among device- and technology-based interventions, virtual reality (VR) stood out for the consistency of results and its ability to cognitively engage the child, diverting attention away from the painful stimulus. [14, 16, 21, 22] The studies included in this review reported a significant reduction in pain and fear during vaccination with the use of VR, making it a highly effective distraction tool during pediatric invasive procedures.

Cold- and vibration-based methods, such as the Buzzy® device, also showed robust evidence of effectiveness. These findings support the physiological "gate control" theory of pain, according to which sensory stimuli compete with nociceptive signals, reducing their perception. [12, 13, 15] Its practical and straightforward application facilitates implementation in public healthcare services.

Although technological interventions may require greater resource availability and additional costs, the results suggest significant potential for improving the pediatric vaccination experience, especially in children with higher levels of anxiety or needle fear.

Accessible Strategies and Clinical Applicability

Overall, the analyzed studies demonstrate that non-pharmacological methods are effective, safe, and feasible interventions for reducing pain, fear, and anxiety during childhood vaccination, regardless of age group or care setting. The diversity of identified devices and techniques shows that simple and accessible strategies can be incorporated into routine vaccination services, contributing to the humanization of care.

By integrating studies with different methodological designs, the integrative review not only enables the identification of effective interventions but also provides an understanding of their context of application, reported challenges, and the perceptions of children, parents, and healthcare professionals. This broader approach allows for a more comprehensive understanding of the feasibility and acceptability of the strategies, which are essential elements for their routine adoption.

However, it is important to acknowledge that some studies presented small sample sizes or methodological limitations, such as lack of blinding or insufficient standardization of assessment instruments. These aspects highlight the need for multicenter clinical trials with greater methodological rigor to confirm effectiveness and support practical recommendations.

In summary, the evidence suggests that the incorporation of non-pharmacological methods into vaccination practice can improve the child's experience, strengthen the bond with healthcare services, increase family satisfaction, and contribute to addressing vaccine hesitancy. Thus, the adoption of these interventions represents a promising strategy to enhance the quality of primary care and promote equity in access to immunization.

Finally, the implementation of these interventions in primary healthcare requires nurses and managers to assess the feasibility and cost of each method, selecting low-cost and highly applicable strategies such as mobile device videos, or technologies like virtual reality in settings with greater resource availability. The safety of these non-pharmacological practices is high; however, their effectiveness depends on staff training in behavioral management and appropriate use according to the child's age group, prioritizing bonding-based methods for infants and cognitive distraction strategies for older children. These implications reinforce that organizing the workflow in vaccination rooms and ensuring professional preparedness are essential to humanize care and reduce vaccine hesitancy.

Limitations

This study presents some limitations that should be considered when interpreting its results. First, the literature search was conducted in three international databases (SciELO, PubMed, and Web of Science), which, although they include important sources of scientific literature in the health field, may not encompass all available publications on the topic.

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The exclusion of articles not freely available in full text may have introduced availability bias and restricted access to potentially relevant evidence. In addition, the non-inclusion of gray literature, such as undergraduate theses, dissertations, doctoral theses, and conference proceedings, may have resulted in publication bias, as relevant studies not published in indexed journals may not have been captured in the analysis.

The adopted time frame (2019–2025) may have limited the inclusion of potentially relevant earlier studies, although this period was intentionally chosen to identify more recent scientific evidence on strategies for pain relief during childhood vaccination.

Another limitation relates to the possible exclusion of relevant studies due to the search strategies and eligibility criteria adopted, which are inherent to the selection process in literature reviews.

Despite these limitations, it is believed that the results presented contribute to the systematization of recent scientific knowledge on non-pharmacological interventions for pain relief during childhood vaccination, providing relevant support for healthcare practice and for the development of future research in the field.

Conclusion

The non-pharmacological interventions identified in this review demonstrated potential to reduce pain, fear, anxiety, and discomfort during childhood vaccination. Affective-behavioral strategies, such as breastfeeding, distraction, and non-nutritive sucking, as well as device- and technology-based interventions, such as virtual reality and vibration and cooling devices, showed positive results in children's vaccination experience.

It is noteworthy that many of these interventions are low-cost, easy to implement, and have the potential to be incorporated into vaccination services, contributing to the humanization of care and more positive vaccination experiences. Furthermore, the findings reinforce the importance of adopting pain management strategies during childhood vaccination, considering their potential influence on family adherence to immunization schedules.

It is recommended that further studies with greater methodological rigor and evaluation across different care settings be conducted in order to expand the evidence on the effectiveness and applicability of these strategies in the context of childhood vaccination.

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