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Original research article

COMPARISON OF FOUR NON-PHARMACOLOGICAL METHODS OF PAIN RELIEF DURING VENIPUNCTURE IN CHILDREN

Marie Lulková [1, 2] *, Iva Brabcová [1], Jaroslav Škvor [2]

[1] *University of South Bohemia in České Budějovice, Faculty of Health and Social Sciences, České Budějovice, Czech Republic*
[2] *Department of Pediatrics, Masaryk Hospital, Krajská zdravotní, a.s., affiliated with the Faculty of Health Studies, Jan Evangelista Purkyně University, Ústí nad Labem, Czech Republic*

Abstract

Introduction: Venipuncture is a standard invasive procedure in children that causes pain, leading to procedural anxiety. It emphasises the clinical importance of adequate analgesia and the need to identify effective non-pharmacological procedures.

Goal: This study primarily aims to comparatively evaluate the analgesic efficacy of four non-pharmacological interventions: Buzzy® vibrating device, local cooling, felinotherapy, and oral stimulation with a lollipop – compared to standard care (control group) in children aged 4–11 years undergoing venipuncture. The secondary goal was to compare the assessment of pain intensity by the child and the parent.

Methods: A prospective five-arm randomised controlled trial included 125 children (25 in each arm). The child and the parent assessed pain intensity immediately after the procedure using the Wong–Baker face scale (WBF 0–5). One-factor analysis of variance (ANOVA) with *post-hoc* Tukey's test ($\alpha = 0.05$) was used to compare the mean values of the Wong–Baker face scale between groups.

Results: The Buzzy® device showed the lowest average pain value according to the children (WBF 1.96 ± 0.90) and was significantly more effective than the lollipop and the control group ($p < 0.05$). Local cooling (WBF 2.50 ± 1.16) was the second most effective method. The effect of felinotherapy (WBF 2.71 ± 1.16) was not statistically different from the control group (WBF 2.96 ± 1.31). Oral stimulation with a lollipop (WBF 3.79 ± 1.08) was the least effective. According to their perception, parents systematically underestimated children's pain (average difference in WBF –0.96 points). Neither the age nor the gender of the children influenced the effectiveness of the interventions.

Conclusion: Buzzy® vibrating device is the most effective researched non-pharmacological intervention for reducing pain during venipuncture in children aged 4–11 years. Local cooling is also an effective and affordable alternative.

Keywords: *Buzzy; Felinotherapy; Non-pharmacological methods; Paediatric analgesia; Procedural pain; Venipuncture*

INTRODUCTION

Effective pain management during venous blood sampling in paediatric patients represents a significant clinical challenge. The procedural pain that children experience during such procedures has a demonstrably negative impact on the diagnostic or therapeutic process, and can also lead to the development of long-term psychological consequences. These include, for example, phobias about medical procedures, anxiety, or a negative attitude towards health care that can persist into adulthood and complicate future necessary medical interventions. At the same time, venipuncture is one of the most frequent invasive proce-

dures in paediatrics, so the development, validation, and implementation of effective and child-acceptable analgesic strategies are a key aspect of quality and empathic pediatric care.

Although there are pharmacological options for pain relief, such as local anaesthetics, their onset of action may be too slow for acute situations. For this reason, non-pharmacological methods are often preferred in practice, as they can offer quick relief and are easy to apply. Professional literature describes various approaches, for example, the use of vibration-cooling devices or audiovisual distractions, the effectiveness of which has been confirmed in some studies (Bergomi et al., 2018; Isıyel et al., 2023; Moadad et al., 2016; Sikorová and Bartošíková, 2019). However, there is still less convincing scientific evidence for other methods, such as felinotherapy (contact with an animal) or oral stimulation (e.g., with a lollipop). Thus, there remains a need to not only identify and validate other effective and easily applicable methods of analgesia, but above all to perform a direct comparison of several such interventions within one controlled research design. An important aspect is a deeper understanding of possible differences in the subjective perception and evaluation of pain by the child and their parent, which may have implications for clinical practice and the design of future studies. The issue of agreement between the assessment of pain by the child and the caregiver was investigated, for example, by Lawson et al. (2021) in the context of emergency care. However, in the Czech environment, a comprehensive study comparing the pain perception of a child and a parent during venipuncture has not yet been conducted.

Therefore, the main goal of the present study was to comparatively evaluate the analgesic effectiveness of four different non-pharmacological methods: oral stimulation (licking a lollipop), application of a vibrating device (Buzzy®), local cryotherapy (cooling the injection site), and felinotherapy (contact with a cat) – compared to standard care (control group) during venipuncture in children aged 4–11 years.

Sub-objectives of the study included:

- Comparison of the subjective assessment of pain intensity by the child and their parent (using the visual analogue scale – WBF).
- Evaluation of the potential influence of the child's age and gender on the perceived pain and effectiveness of the individual investigated methods.
- Verification of the practical feasibility of individual non-pharmacological interventions in the conditions of ordinary outpatient paediatric practice.

MATERIALS AND METHODS

Study design

This was a prospective randomised controlled study with five parallel arms. The research was carried out in the outpatient section of the Children's Clinic of the FZS UJEP Masaryk Hospital in Ústí nad Labem, KZ a.s., from January to December 2022.

Research sample

125 children indicated for venous blood collection were included in the study.

Sample size calculation: The sample size was determined using the G*Power 3.1 program (ANOVA: fixed effects, omnibus, one-way). At an expected effect size f = 0.373 [corresponding to a clinically relevant difference of 1.0 points on the Wong–Baker Face Scale (WBF) at a standard deviation (SD) = 1.2)], a significance level of $\alpha = 0.05$, and a required power of the $1–\beta$ test = 0.80, the analysis determined the minimum required number of 18 children per group ($N = 90$). By enrolling 25 children into each of the five groups ($N = 125$), the achieved power of the test increased to 0.92, making it possible to detect statistically significant differences in pain intensity between the groups as early as 0.84 points on the WBF scale.

Criteria for inclusion in the study:

- Age 4–11 years (including, on the date of the venipuncture).
- Indications for taking venous blood for diagnostic or therapeutic reasons.
- Signed written informed consent of at least one of the parents or legal representative.
- Verbal consent of the child to participate in the study, adequate to their age and ability to understand.

Criteria for exclusion from the study:

- Administration of anxiolytic or analgesic medication 24 hours or less before the planned procedure.
- The presence of acute pain of a different origin than the expected pain from venipuncture
- Known allergy to cat fur (relevant to the felinotherapy).
- The presence of a cognitive disorder or developmental delay that would make it impossible for the child to understand the instructions and correctly use the WBF scale.
- Unsuccessful first venipuncture (to ensure standardisation of the procedure and to minimise additional stress).

Randomisation and allocation to groups

Stratified block randomisation was used. Participants were stratified according to two criteria: gender (boy/girl) and age category (4–7 years / 8–11 years), resulting in four losses. For each loss, a randomisation list with blocks of 30 positions (containing six positions for each of the five interventions) was generated by computer. The allocation to a specific group took place through opaque, sealed envelopes opened by the research nurse only immediately before the start of the intervention. This procedure (hidden allocation) ensured an even distribution of participants into the individual arms of the study and minimised the risk of selection bias.

Intervention protocols

1. *Oral stimulation (lollipop):* The child was given a standard fruit lollipop (Chupa Chups, strawberry flavour) two minutes before the start of the venipuncture, which he could lick and continue to lick during the procedure itself (Fig. 1).
2. *Vibrating device (Buzzy®):* The Buzzy® Mini Healthcare device was used for this intervention group. Although this device typically uses a combination of vibration and cold to desensitise nerve endings leading to painful stimuli and subsequently reduce perceived pain, within the design of our study, it was decided to test these two factors (vibration and cold) separately. Therefore, only the vibration function of the Buzzy® device was used in this group. The device was placed on the skin approximately 5 cm proximal to the planned injection site. The vibrations were activated 30 seconds before the start of the venipuncture. They remained active throughout the procedure (Fig. 2). The effect of the cold was tested in a separate intervention group (see Local cryotherapy).
3. *Local cryotherapy (cooling):* A standardised gel pad (dimensions approx. 10 × 5 cm, manufactured by Nexcare™) cooled to a temperature of 4 °C was applied directly to the planned injection site for 10 minutes before venipuncture (Fig. 3).
4. *Felinotherapy:* A certified therapy cat of the Turkish Angora breed, used to contact with children and the hospital environment, was placed on the child's lap (on a disposable mat) five minutes before the start of the venipuncture, and remained with the child throughout the procedure if the child wished it. It was safe (Fig. 4).
5. *Control group:* The children in this group underwent venipuncture in a standard way, without the application of any specific non-pharmacological intervention aimed at reducing pain beyond the scope of everyday, calm, and supportive communication.

Data collection

Venipunctures were performed by two experienced pediatric nurses who, before the study, underwent standardised training focused on exact adherence to research protocols and minimisation of performance variability.

The primary monitored outcome was the intensity of pain perceived by the child. The Wong–Baker FACES Pain Rating Scale (WBF), initially described by Wong and Baker (1988), was used to measure it. For this study, a version of the scale modified for the internal needs of a medical facility was used with a range of 0–5 points, where individual points and assigned faces corresponded to the following pain descriptors: 0 = no pain, 1 = a little pain, 2 = a little more pain, 3 = much more pain, 4 = a lot of pain, 5 = the most pain. The standard, original version of the Wong–Baker face scale uses a range of 0–10 points (with one face corresponding to each even number). The use of facial scales for pain assessment in children follows the recommended procedures of

Fig. 1 – Venipuncture with a lollipop

Fig. 2 – Venipuncture with Buzzy®

Fig. 3 – Venipuncture with cooling

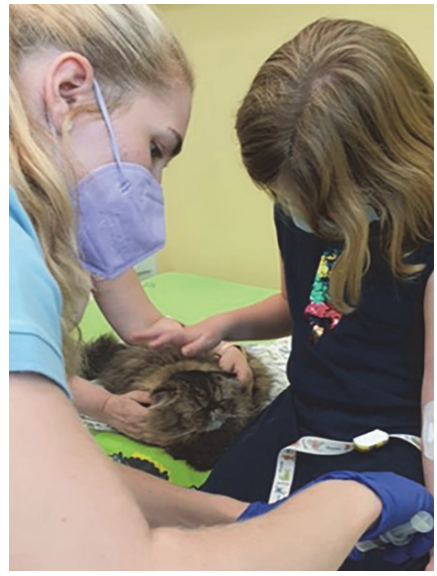

Fig. 4 – Venipuncture with felinotherapy

the Ministry of Health of the Czech Republic for the care of patients with pain (2020). Immediately after completing the venipuncture, the child chose the face on the scale that best corresponded to his feeling of pain (with the possible help of the nurse in understanding the instructions, not in selecting the value). Subsequently, independently of the child, the accompanying parent/legal representative also marked the face corresponding to his estimate of the intensity of the child's pain on the same scale (he or she evaluated how they thought the child felt the pain).

Secondary monitored outcomes included:

- The feasibility of individual methods in the conditions of ambulatory practice, evaluated in the form of a verbal evaluation by the participating nurses after the interventions.
- The difference between the assessment of pain by the child and the parent.
- Evaluation of the potential influence of the child's age and gender on the perceived pain and effectiveness of the individual investigated methods.

Statistical analysis

Statistical data analysis was performed using SPSS version 27.0 software (IBM Corp., Armonk, NY, USA).

The normality of the distribution of continuous data (WBF values) was tested using the Shapiro–Wilk test. To compare the primary outcome (pain intensity according to the child's VAS) between the five study parts, the Kruskal–Wallis test was used (in the case of non-normal data distribution or the ordinal nature of the scale, normality tests were confirmed) or one-factor analysis of variance – ANOVA (in the case of normal distribution). In case of a statistically significant result, *post-hoc* tests were performed for pairwise comparisons: Mann–Whitney *U* tests with Bonferroni correction (for the Kruskal–Wallis test) or Tukey's HSD test (for ANOVA).

Spearman's rank correlation coefficient and Bland–Altman analysis were used to establish the agreement between the child's and parent's pain assessment. The influence of age and gender on pain intensity and individual intervention effectiveness was evaluated using two-factor ANOVA or other appropriate regression models.

The level of statistical significance was set at $p < 0.05$ for all tests.

Ethical aspects

The study was designed and carried out following the ethical principles of the Declaration of Helsinki, which was revised in 2013. The research project was approved by the Ethics Committee of Krajská zdravotní, a.s., and was given an affirmative opinion (proceedings number – 272 B/1). Written informed consent was obtained from the parents/legal representatives of all children in the study before starting any study procedures. The purpose and course of the study were explained to the children in a manner appropriate to their age and cognitive abilities, and verbal permission to participate was obtained from them. All data was anonymised and processed following the applicable legislation on the protection of personal data.

RESULTS

Sample characteristics

125 children were included in the final analysis, of which 64 were boys (51.2%) and 61 were girls (48.8%). The average age of the participants was 7.4 ± 2.1 years (range 4–11 years). Five intervention groups were balanced, each containing 25 participants. No statistically significant differences in the distribution of gender (χ^2 test, $p > 0.20$) or age (ANOVA, $p > 0.20$) were found between the groups.

Pain intensity according to the intervention method

The median and interquartile range (IQR) of pain intensity assessed by children using the Wong–Baker face scale (WBF 0–5) for individual groups are shown in Table 1. The Kruskal–Wallis test revealed a statistically significant difference in pain intensity between the five groups [H (4) =22.9; $p < 0.001$]. Median values and IQR also show which non-pharmacological techniques were clinically most effective. The Buzzy® group showed the lowest median and average (1.96 ± 0.90 WBF points), confirming its superiority over other interventions. Local cooling and felinotherapy reached almost identical medians (2–3 points), while cooling had a slightly smaller variance. The control group without specific intervention (median 3 points) served as the reference line of the standard procedure. On the contrary, oral stimulation with a sweet taste was the least effective, and the children rated it on average almost 2 points worse than Buzzy® (3.79 ± 1.08 points).

These differences and the right-skewed data distribution further support non-parametric tests and underline the practical importance of the detected Buzzy® effect compared to other methods.

Table 1 – Pain intensity (child's WBF) according to the intervention method

Order	Intervention method	*n*	Average ± SD	Median (IQR)
1	BUZZY®	25	1.96 ± 0.90	2 (1–3)
2	Local cooling	25	2.50 ± 1.16	2 (2–3)
3	Felinotherapy	25	2.71 ± 1.16	3 (2–3)
4	Control group	25	2.96 ± 1.31	3 (2–4)
5	Oral stimulation	25	3.79 ± 1.08	4 (3–5)

Note: SD – standard deviation, IQR – interquartile range

Post-hoc analysis using the Mann–Whitney *U* test with Bonferroni correction for multiple comparisons showed the following statistically significant differences:

- Buzzy® vs. oral stimulation (pBonf = 0.003);
- Buzzy® vs. control group (pBonf = 0.013);
- local cooling vs. oral stimulation (pBonf = 0.020).

Other pairwise comparisons after Bonferroni correction did not reach statistical significance (pBonf > 0.05). The vibrating device Buzzy® thus achieved the lowest values of perceived pain and was significantly more effective than the standard procedure (control group) and oral stimulation. Local cooling also showed a tendency to reduce pain compared to oral stimulation. Felinotherapy was not statistically significantly different from the Buzzy® method, local cooling, or the control group, but showed a trend towards less pain than the control group. However, this difference was not statistically significant. Oral stimulation (lollipop) was associated with the highest pain values.

Evaluation comparison – child vs. parent

A strong positive correlation was found between the assessment of pain intensity by the child (WBF child) and the assessment by the parent (WBF parent) (Spearman's coefficient $\rho = 0.75$; $p < 0.001$). Bland–Altman analysis revealed a mean difference (WBF child–WBF parent) of 0.96 points (95% limits of agreement: –0.88 to 2.80). This result indicates that parents tended to slightly underestimate the intensity of pain perceived by their children, on average by almost 1 point on the WBF scale (0–5).

The effect of age on the effectiveness of interventions

To analyse the effect of age, the participants were divided into two categories: younger preschool/school age (4–7 years, $n = 60$) and older school age (8–11 years, $n = 65$). A two-factor ANOVA with the factors "method" (5 levels) and "age group" (2 levels) was performed for the child's assessment of pain (WBF child). The analysis confirmed the method's statistically significant main effect ($F_{4,110} = 6.99$; $p < 0.001$). However, the main effect of age group was not statistically significant ($F_{1,110} = 0.77$; $p = 0.382$). Likewise, no statistically significant interaction between method and age group was found ($F_{4,110} = 0.37$; $p = 0.830$). This indicates that the effectiveness of individual non-pharmacological interventions was consistent across both monitored age categories. Descriptive statistics for particular methods and age groups are presented in Table 2.

The influence of gender on the effectiveness of interventions

An analogous two-factor ANOVA was performed with the factors "method" (5 levels) and "gender" (boys, $n = 64$ vs. girls, $n = 61$). Again, a statistically significant main effect of the method was confirmed ($F_{4,110} = 6.94$; $p < 0.001$). The main effect of gender was not statistically significant ($F_{1,110} = 0.09$; $p = 0.77$). The interaction between method and gender was also not statistically significant ($F_{4,110} = 0.35$; $p = 0.84$). These results indicate that the effectiveness of the investigated non-pharmacological interventions did not differ between boys and girls. Descriptive statistics for individual methods and gender are presented in Table 3.

Table 2 – Average pain intensity (WBF child ± SD) according to method and age group

Intervention method	Age 4–7 years (*n*)	Age 8–11 years (*n*)
Buzzy®	1.9 ± 0.9 (12)	2.0 ± 0.9 (13)
Local cooling	2.4 ± 1.2 (14)	2.6 ± 1.1 (11)
Felinotherapy	2.6 ± 1.1 (12)	2.8 ± 1.2 (13)
Control group	3.1 ± 1.2 (11)	2.8 ± 1.4 (14)
Oral stimulation	3.9 ± 1.1 (11)	3.7 ± 1.1 (14)
Note: The numbers (*n*) correspond to the actual distribution of participants and are consistent with the total number of 25 children per group and with the total distribution of the group by age and gender		

Table 3 – Average pain intensity (WBF child ± SD) according to method and gender

Intervention method	Boys (*n*)	Girls (*n*)
Buzzy®	1.9 ± 0.9 (13)	2.0 ± 1.0 (12)
Local cooling	2.4 ± 1.1 (13)	2.6 ± 1.2 (12)
Felinotherapy	2.8 ± 1.3 (12)	2.6 ± 1.0 (13)
Control group	2.9 ± 1.3 (13)	3.0 ± 1.3 (12)
Oral stimulation	3.8 ± 1.0 (13)	3.8 ± 1.2 (12)
Note: The numbers (*n*) correspond to the actual distribution of participants and are consistent with the total number of 25 children per group and with the total distribution of the group by age and gender		

Feasibility of methods

The feasibility of individual non-pharmacological interventions was evaluated based on a summary verbal evaluation by the participating nurses after data collection for all intervention groups. According to their summary, most tested methods were perceived as easy to implement in the conditions of a regular pediatric clinic. Specifically, local cooling and applying the Buzzy® device were marked as problem-free and well integrated into routine practice. With oral stimulation (lollipop), the nurses noted that, as a potential complication, some parents refuse to give sweets to their children. The nurses evaluated felinotherapy as feasible under specific organisational conditions, such as a certified therapy cat's availability and a suitable, quiet space. However, they perceived problematic aspects of this method to be the potential deterioration of environmental hygiene due to shedding of animal fur and the general frequent occurrence of allergies to animal fur in children, which could limit its wider use despite an exclusion criterion for allergy sufferers within the study. A detailed qualitative analysis of the nurses' comments is not the subject of this communication.

DISCUSSION

The present study aimed to comparatively evaluate the analgesic effectiveness of four different non-pharmacological pain relief methods during venipuncture in children aged 4–11 years and to compare the assessment of pain by the child and the parent. The key finding is that the intervention using the vibrating device Buzzy® was the most effective in reducing the intensity of pain perceived by children. Children in this group reported statistically significantly lower pain values on the Wong–Baker face scale (WBF) compared to the control group with standard care and the group with oral lollipop stimulation. This result is consistent with several previous studies (Cho et al., 2022; Susam et al., 2018), which have pointed to the effectiveness of the combination of vibration and cold, the effect of which is explained by the principles of the gateway theory of pain (Melzack and Wall, 1965) and the impact of distraction. It is important to emphasise that the commercially available Buzzy® product uses the synergistic action of vibrations and cold as standard. In our study, only the vibration component of this device was intentionally tested so that

we could assess its contribution in isolation. Even the vibration demonstrated a significant analgesic effect, indicating its key role in the device's mechanism of action.

Local cooling of the injection site, tested as a separate intervention, also proved to be a relatively effective method that reduced pain compared to oral stimulation. This finding supports the use of cryotherapy as a simple and accessible method, which corresponds to the findings of some authors (e.g., Dhingra et al., 2022; Lakshmanan and Ravindran, 2021; Sayed et al., 2020). However, other studies point to variable effectiveness depending on the length and method of cold application (e.g., Fathalla and Bayoumi, 2018; Susam et al., 2018), which may explain why, in our case, the effect was not as pronounced as with vibration stimulation. The fact that both isolated vibration and isolated local cooling showed a positive analgesic trend in our study (with vibration being statistically significantly more effective in some comparisons and cooling in one) strongly suggests that their combined use, as in the standard application of the Buzzy® device, could lead to an even greater reduction in perceived pain. This hypothesis, supported by the principle of multimodal analgesia, deserves further verification in future studies.

In some contexts, felinotherapy is described as a method of reducing stress and anxiety in children and adults (e.g., Demiralay and Keser, 2022), but our study did not show a statistically significant analgesic effect compared to the control group. Although a trend towards lower pain values was indicated, this difference did not reach statistical significance. It is possible that a short-term single exposure to a cat immediately before and during the procedure is not sufficient to achieve significant analgesia in procedural pain. The effect of felinotherapy can be more focused on the overall reduction of anxiety and improvement of the emotional state, which may not be directly and immediately reflected in the decrease in the perceived intensity of acute pain. Our findings regarding the limited direct analgesic effect of short-term felinotherapy are in line with some other studies that also did not show a significant impact on short-term interventions aimed at acute pain (e.g., Braun et al., 2009), while other studies indicate a positive effect on psychological aspects (e.g., Demiralay and Keser, 2022). Interpreting this result requires considering the specifics of our intervention and context.

A surprising finding was that oral lollipop stimulation was ineffective and associated with the highest perceived pain values, even higher than in the control group (although this difference was not statistically significant compared to the control). This result is in stark contrast to numerous studies that demonstrate the analgesic effect of sweet taste (e.g., sucrose or glucose solutions) and sucking, especially in newborns, infants, and toddlers (e.g., Despriee and Langeland, 2016; Stevens et al., 2016). In older children in our group (4–11 years), however, the mechanism of action may be different or less potent. Manipulation with the lollipop could have had a somewhat distracting effect, distracting attention from other potentially more effective coping strategies, or could have led to an increased expectation of an unpleasant experience. An extensive Cochrane review evaluating the effectiveness of sugar solutions for reducing procedural pain in children aged 1–16 years (Harrison et al., 2015) pointed out that while the evidence for younger children (especially up to 12 months) is quite consistent, for older children the data is less conclusive, and the quality of the evidence is often lower. Some included studies did not show a significant effect in older children. Our results thus correspond with the conclusions of this review on the need for further research and the lower robustness of the evidence on the effectiveness of oral stimulation with sweets in older children. At the same time, our study further supports this skepticism for the given age category and type of intervention (lollipop). It is necessary to discuss why our findings differ from studies demonstrating an effect in younger children.

Another important and clinically relevant finding is the confirmation of a consistent discrepancy between the assessment of pain by children and their parents. Parents in our study tended to systematically underestimate the intensity of their children's pain, on average by almost one point on the WBF scale. This phenomenon was also described in other studies, e.g., in the recent work of Lawson et al. (2021). This finding underlines the key need to primarily rely on the child's self-assessment of pain if the child can provide it.

It emphasises the importance of educating parents and medical personnel about possible differences in the perception and interpretation of children's pain. The significance of this finding lies in the potential for inadequate pain management if clinicians rely solely on parental assessment.

Our study did not confirm a statistically significant effect of age (within the observed range of 4–11 years divided into two subgroups) or gender on the overall perceived pain or the effectiveness of individual non-pharmacological interventions. This suggests that the most effective researched methods, such as the vibrating device Buzzy® (or its vibrating component), could be relatively universally applicable across this age spectrum, regardless of the child's gender. The question of the effect of age and gender on the effectiveness of distraction and physical methods is discussed in the professional literature with ambiguous conclusions. While some findings suggest consistent effects across these demographic groups, others point to possible nuances, such as potentially higher sensitivity to pain in girls, or differential preference or effectiveness of coping strategies depending on age. Our results contribute to this discussion with knowledge about the consistency of the effect in our particular set and the tested methods.

Strengths and limitations of the study

The strengths of this study include its prospective randomised controlled design with five parallel arms, which allowed direct comparison of multiple non-pharmacological methods. Standardised protocols for interventions and data collection, performed by trained personnel, contributed to internal validity. A limitation of the study is primarily the impossibility of completely blinding the participants and staff to the type of intervention applied in some methods (e.g., felinotherapy, Buzzy®, lollipop), which could potentially affect the subjective evaluation. The assessment of pain is inherently subjective and can be influenced by several other factors, such as previous experience with pain, current emotional state, child's temperament, or level of parental anxiety, which were not controlled in detail in all aspects. However, randomisation should contribute to their equal distribution between groups. For practical reasons, data on children's anxiety before the performance was not systematically collected, which could provide additional context for the interpretation of the results. As mentioned in the methodology, the feasibility of the methods was evaluated by the nurses in summary after the the data collection, which is more of a global view; a detailed analysis of the feasibility and acceptability of individual methods from the point of view of children, parents, and nurses immediately after each intervention would have provided richer data, but was not the subject of this primary effectiveness analysis. The decision to test the vibration and cold components of the Buzzy® device separately, although methodologically valuable for isolating effects, does not allow direct generalisation to the standard combined use of this device, which should be considered when interpreting the significance for clinical practice.

Implications for practice and future research

The results of our study indicate that vibration stimulation alone, represented by the Buzzy® device (without an active cold component), represents an effective and efficiently implemented non-pharmacological method for reducing pain during venipuncture in children aged 4–11 years. Local cooling is also beneficial and can serve as an available alternative. Given that both modalities have shown a positive effect, it can be assumed that their combination, as with the standard Buzzy® device, could offer an even more pronounced analgesic effect. On the contrary, oral stimulation with a lollipop does not appear to be a suitable analgesic strategy for venipuncture in this age group. The finding of a discrepancy in the assessment of pain between children and parents should lead to increased emphasis on obtaining self-assessment from children and to caution in the interpretation of pain assessment by parents.

Future research should directly compare the effectiveness of the standard combined (vibration-cold) Buzzy® device with its isolated components and topical pharmacological anaesthetics, providing a more comprehensive view of optimal pain management. Furthermore, it would be beneficial to examine the mechanisms and optimal conditions for felinotherapy in more detail, e.g., the effect of length and frequency of exposure or its com-

bination with other relaxation techniques. Including more objective physiological indicators of stress and pain (e.g., heart rate, heart rate variability, and cortisol level in saliva) could complement the subjective evaluation and contribute to a more robust verification of the effectiveness of individual methods. It would also be interesting to investigate the influence of the child's characteristics (e.g., anxiety level, coping styles) on the efficacy of various non-pharmacological approaches.

CONCLUSION

Based on the analysis, it can be concluded that of the non-pharmacological methods tested, isolated vibration stimulation (Buzzy® device), followed by local cooling, proved to be the most effective for reducing pain during venipuncture in children aged 4–11 years. Oral stimulation with a lollipop was not effective in this age group. The study also confirmed the tendency of parents to underestimate their children's pain. Considering the proven effectiveness of isolated vibration and the positive trend in local cooling, it can be reasonably assumed that the standard combined use of the Buzzy® vibration-cooling device could offer an even more significant analgesic benefit. These findings may contribute to the optimisation of clinical practice in the management of procedural pain in children.

For the effective implementation of this knowledge in broader clinical practice, we recommend:

- Including vibration stimulation in standard protocols for the management of procedural pain in children in pediatric facilities.
- Systematic training of medical personnel (primarily nurses and doctors) in using non-pharmacological methods.
- Considering including devices such as Buzzy® in the basic equipment of clinics and departments where invasive procedures are performed on children.
- Explore the possibilities of integrating and standardising these approaches in different types of medical facilities further to maximise their benefit for pediatric patients.

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Ethical aspects and conflict of interest
The authors have no conflict of interest to declare and confirm that all photographs used in this study were taken with the informed consent of the participants.

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*** Corresponding author:** Marie Lulková, Department of Pediatrics, Masaryk Hospital, Krajská zdravotní, a.s., affiliated with the Faculty of Health Studies, Jan Evangelista Purkyně University, Ústí nad Labem, Czech Republic; e-mail: marie.lulkova@kzcr.eu
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