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Non-Pharmacological Interventions to Reduce Pain and Fear in Children Undergoing IV Cannulation: A Randomized Controlled Trial

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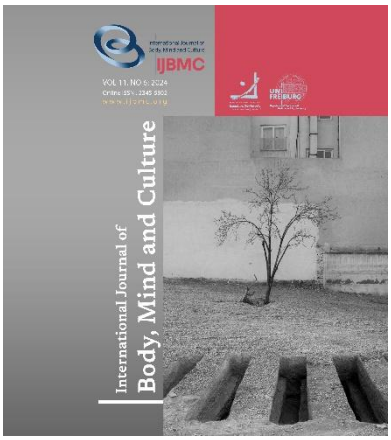

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ABSTRACT

Objective: Distraction techniques are among the most effective nursing interventions for managing pain and fear in children undergoing IV cannulation. Techniques such as bubble blowing, cartoons, and the Buzzy device help children cope with procedural pain and anxiety better. This study aims to assess the levels of pain and fear experienced during IV cannulation in preschool-aged children and to determine the effectiveness of distraction techniques in reducing these levels.

Methods and Materials: A randomized controlled trial was conducted on 60 preschool-aged children undergoing IV cannulation at Karbala Children's Teaching Hospital. Participants were randomly assigned to three intervention groups (Buzzy device, cartoon film, and bubbles game) and a control group. Pain levels were measured using the Wong-Baker FACES Pain Rating Scale, and fear levels were assessed with the McMurtry Children's Fear Scale during and after the procedure. Data analysis was performed using SPSS.26. Descriptive statistics and ANOVA (Analysis of Variance) were employed to evaluate group differences, with a significance level set at $p \leq .05$.

Findings: Findings indicate that the Buzzy device was most effective in reducing pain ($P<0.001$). At the same time, the bubbles game proved most effective in reducing fear levels ($P<0.001$) following the application of the distraction techniques.

Conclusion: The study concludes that targeted distraction techniques, such as the Buzzy device and bubble blowing, can effectively manage and reduce pain and fear in children undergoing venous cannulation. These findings have practical implications for healthcare professionals, equipping them with effective strategies to improve the pediatric patient's experience during IV cannulation.

Keywords: Non-pharmacological intervention, Pediatric Pain and Fear, IV Cannulation, Distraction Techniques, Randomized Controlled Trial.

Introduction

Pain is a universal human experience and a critical component of clinical care (Hooshmandi et al., 2024; Kaur et al., 2014; Rostami et al., 2024). It is often called the fifth vital sign, emphasizing the need for healthcare providers to monitor and manage it consistently during patient care (Sadeghi et al., 2013). In pediatric care, peripheral intravenous (IV) catheter insertion is among the most distressing procedures for children during hospitalization (Inal & Kelleci, 2012). Peripheral intravenous (IV) cannulation involves inserting a catheter into a peripheral vein, making it an invasive and potentially painful procedure for children (Aydin et al., 2016). If untreated, procedural pain in children can lead to lasting physical and psychological impacts, such as

needle phobia, avoidance of medical care, and non-cooperation in future procedures (Gerçeker et al., 2019). Preemptive measures to reduce pain during IV cannulation are crucial in improving the pediatric patient's experience (Wong et al., 2019).

Research in pediatric pain management has long focused on reducing pain associated with venous cannulation, initially employing local anesthetics as a primary method (Alitabar & Goli, 2023; Alitabar & Zadhasn, 2023; Trottier et al., 2019)—early methods involved using thinner needles to administer local anesthetics at the venipuncture site. Although effective, these techniques posed risks of needle sticks and required additional skill (Srivastava et al., 2016). An eutectic Mixture of Local Anesthetics (EMLA) cream became a preferred technique due to its effectiveness. However, its use is constrained by high costs, required application time, and potential skin reactions (Beecham & Tackling, 2022).

Distraction techniques have emerged as some of the most effective non-pharmacological interventions to alleviate pain and anxiety in children (Koller & Goldman, 2012). Distraction techniques are categorized as active or passive interventions. Active distraction techniques engage the child's senses and skills, encouraging active participation in tasks during painful procedures (Abd El-Gawad & Elsayed, 2015). In contrast, passive distraction requires no active involvement of the child and focuses on engaging their visual or auditory senses (Canbulat Sahiner & Demirgoz Bal, 2016).

Relieving pain is a basic need and right of all children, and health professionals must be willing to try effective interventions to meet this need optimally (Yoo et al., 2011). Passive distraction strategies like watching an animation clip, listening to music, or watching television help reduce pain. Examples of active distraction include playing a console game or engaging with a digital companion (Longobardi et al., 2019). This study explores and evaluates specific distraction techniques, including bubble blowing, using cartoon videos, and the Buzzy device, known to reduce pain and fear during pediatric IV cannulation procedures.

Methods and Materials

Study Design and Participants

A randomized controlled trial (RCT) design was employed to assess the effectiveness of non-pharmacological interventions in reducing pain and fear in children undergoing IV cannulation.

A purposive, non-probability sample of 60 children aged 3 to 5 years was selected from those visiting the IV cannulation unit at Karbala Children's Teaching Hospital. This purposive sampling approach was chosen to ensure the inclusion of children likely to experience distress during cannulation, enhancing the study's relevance and applicability in pediatric settings. While random sampling may improve generalizability, the purposive sampling aligns with the study's clinical focus on preschool-aged children.

Researchers collected observational data during the IV cannulation procedure. Pain and fear levels were assessed at two points, during the procedure and immediately after, to capture the children's immediate reactions to the interventions. Researchers administered the distraction techniques following standardized instructions, with each intervention lasting throughout the cannulation process. Verbal consent was obtained from the children's parents or guardians before data collection, explaining the study's objectives, procedures, potential benefits, and confidentiality measures. Data were collected in a private room prepared for the IV cannulation procedure, ensuring a controlled and consistent environment to minimize external variables affecting the children's responses.

Participants were divided into three intervention groups (Buzzy device, cartoon film, and bubbles game) and a control group. The control group received no specific distraction techniques and was treated according to standard care protocols. In the intervention groups, the distraction techniques were administered by trained staff members who followed standardized instructions to ensure consistency in the duration and manner of each method.

Data Collection Tools

Demographic Questionnaire: Collected information on age, gender, residence (urban or rural), and birth order.

Wong-Baker FACES Pain Rating Scale: The Wong-Baker FACES Pain Rating Scale is a self-report tool

designed to measure pain intensity in children. It comprises six facial expressions ranging from a happy face at 0, indicating "no hurt," to a crying face at 10, representing "hurts worst." Children select the face that best corresponds to their pain level. This scale has demonstrated strong reliability and validity across pediatric populations (Keck et al., 1996; Wong et al., 2019).

McMurtry Children's Fear Scale: The Children's Fear Scale (CFS), adapted from the Faces Anxiety Scale, assesses fear in children undergoing medical procedures. It consists of five faces depicting increasing levels of fear, scored from 0 ("no fear") to 4 ("most fear"). The CFS has shown high concurrent validity with other fear measures and satisfactory test-retest reliability (McMurtry et al., 2011).

Data analysis

Data preparation and preliminary calculations were conducted using Microsoft Excel 2016, and statistical analyses were performed using SPSS software (version 26). Descriptive statistics (frequencies, percentages, means, and standard deviations) were applied to demographic data, pain ratings, and fear scores. Inferential statistics, specifically analysis of variance (ANOVA), were used to test for significant differences between group means. Post hoc tests were conducted when ANOVA indicated statistically significant differences between the groups. A significance level of $p \leq 0.05$ was considered statistically significant.

Findings and Results

The sample included 58.3% boys and 41.7% girls, with 61.7% being the second-born child in their family and 80% residing in urban areas. This demographic distribution is presented in Table 1.

Table 1

Demographic Characteristics of the Study Sample

Characteristic	Buzzy Device	Cartoon Film	Bubbles Game	Control	Total
Gender					
Boys	9 (60%)	9 (60%)	8 (53.3%)	9 (60%)	35 (58.3%)
Girls	6 (40%)	6 (40%)	7 (46.7%)	6 (40%)	25 (41.7%)
Birth Order					
First	3 (20%)	3 (20%)	7 (46.7%)	4 (26.7%)	17 (28.3%)
Second	11 (73.3%)	10 (66.7%)	6 (40%)	10 (66.7%)	37 (61.7%)
Third	1 (6.7%)	2 (13.3%)	2 (13.3%)	1 (6.7%)	6 (10%)
Residence					
Urban	12 (80%)	12 (80%)	11 (73.3%)	13 (86.7%)	48 (80%)
Rural	3 (20%)	3 (20%)	4 (26.7%)	2 (13.3%)	12 (20%)

Table 2

Pain Levels During IV Cannulation Across Intervention and Control Groups

Group	Mild	Moderate	Severe	Mean Score ± SD
Buzzy Device	10	5	0	1.33 ± 0.49
Cartoon Film	7	8	0	1.53 ± 0.52
Bubbles Game	6	9	0	1.60 ± 0.51
Control	0	7	8	2.53 ± 0.52
Total	23	29	8	1.75 ± 0.68

Pain evaluation indicated that all intervention groups (Buzzy device, cartoon film, and bubbles game) reported mild pain. In contrast, the control group exhibited severe pain levels during the IV cannulation procedure. These findings highlight the effectiveness of the distraction techniques in reducing pain intensity among the intervention groups.

Table 3

Fear Levels During IV Cannulation Across Intervention and Control Groups

Group	Mild	Moderate	Severe	Mean Score ± SD
Buzzy Device	9	6	0	1.40 ± 0.51
Cartoon Film	11	4	0	1.27 ± 0.46
Bubbles Game	12	3	0	1.20 ± 0.41
Control	0	7	8	2.53 ± 0.63
Total	33	19	8	1.58 ± 0.70

The fear assessment revealed that all intervention groups reported mild fear levels, whereas the control group experienced severe fear levels during IV cannulations (Table 3). These results indicate the effectiveness of distraction techniques in minimizing fear among the children in the intervention groups.

Table 4

ANOVA Analysis of Pain Levels by Intervention Group

Group	N	Mean ± SD	F-value	df	p-value
Buzzy Device	15	1.33 ± 0.49			
Cartoon Film	15	1.53 ± 0.52	16.657	3	0.001
Bubbles Game	15	1.60 ± 0.51			
Control	15	2.53 ± 0.52			
Total	60	1.75 ± 0.68			

ANOVA results showed a statistically significant difference in pain reduction across groups (p=0.001), indicating that the Buzzy device was the most effective technique for lowering pain intensity compared to other methods (Table 4). Post hoc tests confirmed these results, further distinguishing the effectiveness of each intervention.

Table 5

ANOVA Analysis of Fear Levels by Intervention Group

Group	N	Mean ± SD	F-value	df	p-value
Buzzy Device	15	1.40 ± 0.51			
Cartoon Film	15	1.27 ± 0.46	18.239	3	0.001
Bubbles Game	15	1.20 ± 0.41			
Control	15	2.53 ± 0.63			
Total	60	1.57 ± 0.70			

ANOVA results indicated a statistically significant difference in fear reduction across groups (p=0.001), with the bubbles game being the most effective technique for reducing fear among the children (Table 5). Post hoc analyses supported these findings, confirming the superior impact of the bubbles game on fear reduction.

Discussion and Conclusion

The results demonstrated that all intervention groups experienced mild pain levels compared to the control group, which reported severe pain. These findings align with Inal and Kelleci (2012), who found that distraction techniques can significantly reduce pain perception in pediatric patients (Inal & Kelleci, 2012). This result supports the effectiveness of non-pharmacological interventions in managing procedural pain, particularly in reducing the impact of IV cannulation pain among children. The study found that all intervention groups exhibited mild fear levels, while the control group showed high levels of fear during the procedure. This is consistent with findings by Gerçeker et al. (2019), who reported lower fear levels in children receiving distraction techniques than those in control groups (Gerçeker et al., 2019). These results emphasize the

importance of incorporating distraction techniques to reduce procedural anxiety in pediatric patients.

The analysis revealed that the Buzzy device was the most effective technique in reducing pain intensity, supporting findings by Moadad et al. (2016), who observed significantly lower pain scores in children using the Buzzy device. These findings highlight that the effectiveness of specific distraction techniques may vary, with the Buzzy device being particularly suited for pain reduction and the bubbles game for alleviating fear (Moadad et al., 2016).

This study underscores the practical value of distraction techniques, particularly the Buzzy device and bubbles game, as effective non-pharmacological methods for reducing pain and fear in pediatric IV procedures. These techniques offer a valuable, low-cost option for healthcare providers to improve the hospital experience for children, potentially enhancing cooperation in future medical procedures (Suleman et al., 2022).

The study encountered limitations, including challenges in controlling children's reactions during pain and fear assessments. Additionally, some parents could not participate fully due to time constraints, potentially affecting the data's consistency. These limitations highlight the need for improved data collection processes in future studies to ensure more reliable observations.

Future research could benefit from larger sample sizes and a broader age range to enhance the generalizability of findings. Additionally, studies examining the long-term effects of repeated use of distraction techniques in pediatric settings could provide further insights into sustained pain and fear management. Investigating other non-pharmacological interventions alongside distraction methods may yield valuable information for comprehensive pediatric pain management strategies.

The study concludes that the Buzzy device was the most effective technique for reducing pain. At the same time, the bubbles game proved most effective in reducing fear levels among preschool-aged children during IV cannulation. These findings underscore the importance of incorporating simple, cost-effective distraction techniques into pediatric care settings to alleviate procedural pain and anxiety, potentially improving children's overall hospital experiences. Further exploration of distraction methods in diverse clinical settings and among different age groups could contribute to developing standardized non-pharmacological protocols for pediatric pain management. Such strategies could broadly enhance patient cooperation, decrease procedural distress, and offer a valuable alternative to pharmacological interventions.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical approval was obtained from the Karbala Health Department and the hospital administration, adhering to ethical standards for research involving pediatric populations.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this study.

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