IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Assess The Effectiveness Of Squeezing Ball On Reduction Of Pain During Insertion Of Intra Venous Cannula Among Hospitalized Preschool Children In Selected Hospital At Vijayapur.

Waseem Akram Almel

Associate Professor / HOD of Paediatric Nursing, Bangi Institute of Nursing Sciences, Vijayapura

Abstract: Pain during intravenous (IV) cannulation is a common distressing experience for preschool children, often leading to fear, anxiety, and reduced cooperation during medical procedures. Non-pharmacological interventions such as distraction are recognized as effective, safe, and simple methods for reducing procedural pain. The present study aimed to assess the effectiveness of the squeezing ball distraction technique on reducing pain during IV cannulation among preschool children. A quasi-experimental post-test only control group design was adopted, and 50 preschool children were selected through purposive sampling and divided equally into experimental and control groups. Pain was assessed immediately after cannulation using the Wong–Baker Facial Pain Rating Scale.

Findings revealed that children in the experimental group experienced only mild pain, with 52% reporting "Hurts Little Bit (2)" and 48% reporting "Hurts Little More (4)." In contrast, the control group demonstrated significantly higher pain levels, with 44% reporting "Hurts Even More (6)," 36% "Hurts Whole Lot (8)," and 8% "Hurts Worst (10)." The mean pain score of the experimental group (2.96) was considerably lower than that of the control group (6.80). The calculated t-value of 71.1 at $p < 0.05$ confirmed a highly significant difference between the two groups. Chi-square analysis further showed that demographic variables had no association with pain levels.

The study concludes that the squeezing ball distraction technique is a simple, cost-effective, non-invasive, and highly effective method for reducing pain during IV cannulation among preschool children. This technique can be readily integrated into routine pediatric nursing practice.

Keywords: Pain, distraction, squeezing ball, preschool children, IV cannulation, Wong–Baker Scale.

INTRODUCTION

Pain, a fundamental protective and sensory response, has been characterized as an unpleasant subjective experience arising from actual or perceived tissue injury, emotional threat, or nociceptive stimulation. In pediatric healthcare, pain response is not only a neurophysiological signal but also a behavioral and emotional experience shaped by child development, temperament, prior clinical exposure, caregiver influence, and environmental unfamiliarity. Young children, especially preschoolers, experience procedures as potentially threatening events because their ability to reason medical necessity, project future benefit, or interpret transient discomfort remains cognitively immature. Pain in early childhood has been shown to be multifactorial, involving sensory transmission, emotional distress, fear synergy, arousal dysregulation, and limited self-modulation capacity (1). At this developmental stage, painful healthcare encounters frequently produce exaggerated responses including crying, screaming, withdrawal behavior, protective muscle guarding, refusal to comply, and autonomic nervous fluctuations that can complicate venous access procedures (2). Intravenous (IV) cannulation remains one of the most frequently performed invasive procedures in pediatric wards and emergency departments, required for fluid therapy, antibiotic

administration, blood sampling, perioperative stabilization, imaging adjunct procedures, and drug delivery (3). Despite being clinically essential, IV cannulation is widely described as the most distressing needle-based pediatric procedure, generating both nociceptive pain from tissue penetration and affective pain from perceived threat and anticipatory fear (4).

Preschool children demonstrate heightened vulnerability during invasive procedures because of their limited emotional vocabulary, inability to self-systematize structured coping strategies, dependency on caregiver coregulation, and limited comprehension of hospital procedural cues (5). Research evidence has consistently shown that early negative pain experiences may form implicit long-term memory imprints, reinforcing conditioned fear, needle phobia, hospital resistance, distrust responses toward clinicians, delayed future healthcare engagement, and avoidance of hospitals until the illness becomes severe (6). Exposure to repeated needle procedures, even when clinically successful, may condition defensive behavioral responses and increase child-ANS arousal, indirectly raising future procedural pain perception through emotional amplification (7). Studies have indicated that preschoolers fear the unfamiliar more intensely than they fear the physical sensation itself, meaning emotional threat processing becomes at least as important as nociceptive input in determining observed pain score intensity (8). Pediatric nurses are therefore ethically and clinically positioned to adopt real-time pain mitigation strategies that are child-safe, caregiver inclusive, inexpensive, feasible at bedside, non-interruptive to care, and able to modulate both autonomic stress response and nociceptive pain (9). Pharmacological analgesia is not routinely administered before simple first-attempt IV cannulation because IV insertion pain is expected to be transient, mild to moderate, or insufficient to justify analgesic intervention, meaning that pain control at this stage heavily depends on NPIs initiated by nurses at bedside (10).

Non-pharmacological interventions (NPIs) are recommended in pediatric pain protocols due to their safety, negligible risk, the absence of pharmacological side effects, caregiver compatibility, rapid application, psychological control enhancement ability, developmental suitability, and ability to inhibit pain signals using competing sensory modulation pathways (11). Pain mitigation through NPIs in preschool children is most effective when incorporated using active, multisensory or object-responsive distraction rather than passive visual or auditory engagement alone (12). The Gate Control Theory proposes that competing non-painful sensory stimulation interferes with painful neural impulse transmission at the spinal dorsal horn level, effectively reducing pain perception via receptor-level competition (13). Tactile-gating therapies deliver inhibitory neural interference using mechanical pressure, muscular activity, and proprioceptive stimulation, lowering nociceptive transmission toward higher cortical pain centers (14). Hand squeezing-based sensory devices, especially stress balls, provide dual pain modulation via tactile pressure and motor cortex activation simultaneously, thereby enhancing inhibitory neurobehavioral pain modulation more effectively than passive distraction alone (15). Evidence also shows that motor cortex engagement and muscle contraction tasks during painful procedures provide a neurocognitive diversion pathway that reduces pain hyper-attentional amplification, channels stress arousal into controlled motor discharge, dampens crying intensity, and increases child cooperation with the practitioner performing cannulation (16).

Ball-squeezing therapy has also been described as implicitly play-compatible, delivering distraction synergy through object interaction, motor distraction via hand and arm proprioceptive engagement, stress release channeling, and sensory pain competition, increasing the child's sense of procedural control and reducing perceived helplessness (17). Pediatric pain is frequently worsened by sympathetic arousal–induced peripheral vasoconstriction that makes vein access more difficult, increasing failed attempt risk, procedure time, tissue trauma, and eventual pain intensification (18). Studies show that autonomic stress responses influence procedural pain intensity, crying behavior, tachycardic spikes, respiratory disruption, procedural resistance, vein visibility reduction, and caregiver secondary distress loops created when parents witness exaggerated child responses (19). Inflammation, tissue damage or multiple puncture attempts strongly escalate pain behavior; hence, pain mitigation for **first attempt cannulation procedures** becomes an essential clinical priority to reduce emotional amplification of pain before nociception occurs (20). Nurses often use distraction-based interventions during IV procedures, but distraction alone may not always reduce tactile pain if sensory competition is absent (21). Active tactile engagement interventions, however, have been seen to modulate preschool autonomic responses rapidly, making cannulation smoother for practitioners and less painful for children (22). Moreover, preschool pain measurement requires tools suitable for limited child articulation and primarily depends on facial-based or distress-based pain scoring systems validated for early pediatric cognitive understanding (23). The Wong-Baker FACES Pain Rating Scale is one of the most widely accepted preschool-compatible pain scales due to its face-expression correlation and nurse-friendly bedside administration feasibility (24). However, data validating its use specifically for tactile-gating pain interventions in Indian preschool clinical samples is still emerging (25).

Caregiver-assisted procedural preparation also influences child pain outcomes. When caregivers rehearse coping strategies with nurses before procedures, children show lower fear spikes and improved cooperation (26). Conversely, when parents demonstrate maladaptive reassurance, visible anxiety, or procedural delay behavior, preschool children's pain and fear become amplified (27). Many institutions in India use low-cost, bedside sensory objects such as toys, balls, or squeezable distraction tools to modulate short medical procedures; however, formal clinical evidence validating the causal efficacy of squeezing balls specifically during IV cannulation is still inadequate in Indian nursing research literature (28). Systematic physiological studies show that muscle contraction and repetitive hand motor tasks effectively reduce HPA-driven pain arousal and crying cascades (29). Additional pediatric studies also confirm that hand squeezing objects provide immediate stress channeling causing reduction in distress-linked pain amplification (30). Studies also assert that tactile sensory input generates competing receptor-level neural interference inhibiting pain impulse signaling (31). This mechanism may stabilize ANS activity, improving cooperation especially when the non-cannulating hand is engaged (32). Nurses favor squeezing balls because of their material feasibility, lack of training complexity, caregiver involvement possibility, bedside use applicability even in crowded or rural pediatric settings, and zero pharmacological contraindications (33). Research also shows that perceived control enhancement from motor tasks becomes a mediator reducing pain intensity perception in children (34). Furthermore, ball squeezing therapy has also shown practical benefits lowering behavioral resistance during venipuncture, enabling nurses to perform procedures faster and more accurately (35).

Long-term pain conditioning impact studies show that early unmitigated pain increases hospital avoidance behavior, defensive muscle guarding, distrust responses to clinicians, and fear-memory reinforcement, all of which increase future pain amplification if early encounters are not mitigated using NPIs (36). Indian pediatric nursing research emphasizes that low-cost bedside interventions must be experimentally validated to standardize practice and provide evidence-based recommendations for routine venous access protocols (37). Literature supports immediate pain reduction benefit in preschool cognition when competing tactile sensory input overshadows nociceptive attentional amplification (38). Moreover, pain modulation demands strategies that intervene in real-time cognitive, emotional, physiological, sensory, and behavioral pain pathways simultaneously rather than distraction alone (39). Therefore, squeezing ball therapy represents a strong candidate for pain inhibition research due to its simultaneous motor, proprioceptive, and tactile pain gating mechanisms (40).

Hence, the present study was conceptualized to generate original primary experimental evidence evaluating the effectiveness of squeezing balls on the reduction of pain during IV cannula insertion among hospitalized preschool children in selected Indian hospital wards. The purpose is to validate a structured bedside protocol that nurses can standardize and caregivers can assist without interrupting venous access workflows.

METHODOLOGY

Research Approach

A **quantitative research approach** was adopted to collect, analyze, and interpret the data to answer the research questions.

Group	Intervention	Observation
Experimental Group	X	O_1
Control Group	–	O_2

Research Design

A **True Experimental – Post-Test Only Control Group Design** was employed.

The design structure is as follows:

X: Administration of squeezing-ball technique

O_1: Post-test pain perception score (experimental group)

O_2: Post-test pain perception score (control group)

Setting of the Study

The study was conducted in the pediatric wards of selected hospitals in Vijayapur.

The study includes an independent variable, a dependent variable, and several demographic variables relevant to preschool children undergoing IV cannulation. The independent variable of the study is the squeezing-ball technique, which is introduced as a non-pharmacological intervention to help reduce procedural pain. The dependent variable is the pain perception among preschool children, measured immediately after the IV cannula insertion using an appropriate pediatric pain assessment scale. In addition, several demographic variables are considered to understand potential influences on pain response, including the child's age, gender, previous illness history, prior hospitalization experience, exposure to earlier painful procedures, hand dominance, and other relevant background characteristics that may contribute to variations in pain perception or behavioral responses during the procedure.

Population

The target population for the present study comprised preschool children aged 3–5 years admitted to the pediatric wards of selected hospitals in Vijayapur show in fig. 1.

Sample

The study sample included preschool children aged 3–5 years who were admitted for IV cannulation in selected hospitals at Vijayapur.

Sample Size

Sample size refers to the number of subjects selected to ensure statistically significant findings. The estimated sample size for this study was derived based on:

1. **Level of confidence (1 – α):** 98.5%
2. **Anticipated population proportion (P):** 98.5% (assumed proportion of children experiencing pain during IV cannulation in both groups)
3. **Absolute precision (E):** 5%

The formula used was:

n=Z2P(1−P)E2n = \frac{Z^2 P(1-P)}{E^2}n=E2Z2P(1−P)

Where:

n = required sample size

Z = 1.96 (standard normal value at 95% confidence)

P = 0.985

E = 0.05

To improve projection of results, the sample size was rounded to 25 children in the experimental group and 25 children in the control group.

Sampling Technique

A random sampling technique was used to select the samples for both groups.

Criteria for Sample Selection

Inclusion Criteria

1. Children aged 3–5 years.
2. Children undergoing IV cannula insertion.
3. Children who could understand Hindi, Kannada, or English.

Exclusion Criteria

1. Children with mental impairment.
2. Critically ill children.
3. Children with musculoskeletal problems.

Tools for Data Collection

The tool consisted of three parts:

Part I – Demographic Proforma

Included 8 items: age, sex, education status, dietary pattern, parents' occupation, religion, frequency of injections, severity of pain, and analgesic association.

Part II – Wong-Baker Faces Pain Rating Scale

A visual scale (0–10) used to assess pain intensity in children.

Scale Interpretation:

Score	Interpretation
0	No hurt
2	Hurts little bit
4	Hurts little more
6	Hurts even more
8	Hurts whole lot
10	Hurts worst

Part III – Squeezing Ball Technique

Steps followed:

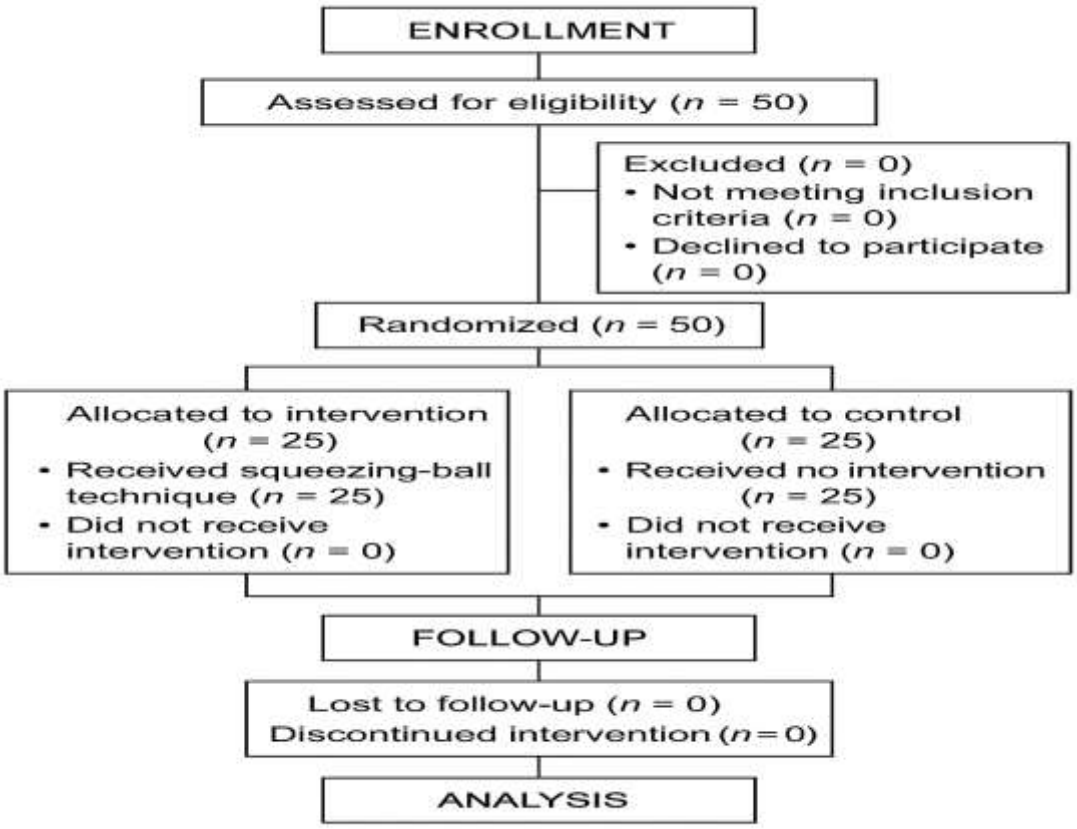
1. Explain the procedure to parents and child.
2. Obtain consent.
3. Provide squeezing ball 10 minutes before IV cannulation.
4. Child holds ball with both hands.
5. Squeeze ball for 30–60 seconds, repeated 10–15 times before cannulation.
6. Continued until completion of IV cannulation.
7. Pain was assessed immediately after cannulation.

Data Collection Procedure

Steps followed:

1. Rapport was established with parents and children.
2. Purpose of the study was explained, and informed consent was obtained.
3. In the experimental group, squeezing-ball technique was administered 15 minutes before IV injection and continued for 15 minutes after.
4. The control group did not receive any distraction technique.
5. Pain levels in both groups were assessed using the Wong-Baker scale.

Fig. 1 Show the CONSORT Flow diagram



RESULTS

Table 1. Show the demographic profile data distribution

Demographic Data	Category	Experimental Group (N=25)	%	Control Group (N=25)	%
Age of child	3 years	03	12%	07	28%
	4 years	08	32%	09	36%
	5 years	10	40%	04	16%
	6 years	04	16%	05	20%
Sex of the child	Male	18	72%	20	80%
	Female	07	28%	05	20%
Education status of the child	Nursery	03	12%	07	28%
	LKG	08	32%	09	36%
	UKG	10	40%	04	16%
	1st Std	04	16%	05	20%
Types of religion	Hindu	09	36%	12	48%
	Muslim	15	60%	10	40%
	Christian	01	4%	02	8%

	Others	00	0%	01	4%
Dietary pattern of the child	Vegetarian	03	12%	01	4%
	Non-Vegetarian	15	60%	10	40%
	Mixed	06	24%	14	56%
	Eggetarian	01	4%	00	0%
Occupation of parents	Govt employee	10	40%	06	24%
	Private employee	11	44%	13	52%
	Business / Self-employed	04	16%	06	24%
Frequency of IV Cannula	Once in a day	12	48%	20	80%
	Twice in a day	12	48%	05	20%
	Thrice in a day	01	4%	00	0%
Association of analgesics	Yes	00	0%	00	0%
	No	22	88%	20	80%
	Sometimes	03	12%	05	20%

Table 1. The demographic characteristics of the children in the experimental and control groups (N=25 each) indicated that both groups were broadly comparable. In terms of age, most children in the experimental group were 5 years old (40%), while the control group had a higher proportion of 4-year-olds (36%), with both groups showing a balanced distribution across the 3–6-year range. Male children predominated in both groups, accounting for 72% in the experimental group and 80% in the control group. The educational status revealed similar patterns, with most children enrolled in UKG (40%) in the experimental group and LKG (36%) in the control group. Religion showed some variation, with Muslim children being the majority (60%) in the experimental group and Hindu children forming the largest group (48%) in the control group. Regarding dietary patterns, most children in the experimental group were non-vegetarian (60%), whereas mixed-diet children predominated in the control group (56%). Parents' occupation showed comparable distribution, with private employment being the most common in both groups (44% and 52% respectively). The frequency of IV cannula insertion differed slightly, as equal proportions of children in the experimental group required cannulation once or twice daily (48% each), while most children in the control group (80%) required it once daily. Analgesic use was minimal in both groups, with 88% of children in the experimental group and 80% in the control group not receiving analgesics. Overall, the demographic variables indicate that both groups were sufficiently similar, allowing for meaningful comparison of outcomes.

Table 2: Severity of Pain – Experimental Group (N = 25)

Severity of Pain (Wong–Baker Scale)	Number	Percentage (%)
No Hurt (0)	00	00
Hurts Little Bit (2)	13	52
Hurts Little More (4)	12	48
Hurts Even More (6)	00	00
Hurts Whole Lot (8)	00	00
Hurts Worst (10)	00	00
Total	**25**	**100**

Table 2. Pain levels of the preschool children were assessed using the Wong–Baker Facial Pain Rating Scale immediately after IV cannulation. The findings revealed a marked difference between the experimental and control groups. In the experimental group, 52% of children reported pain at the level of "Hurts Little Bit (2)" while 48% reported "Hurts Little More (4)." None of the children in this group reported moderate or severe pain levels. This indicates that the squeezing ball distraction technique effectively minimized pain during the procedure.

Table 3: Severity of Pain – Control Group (N = 25)

Severity of Pain (Wong–Baker Scale)	Number	Percentage (%)
No Hurt (0)	00	00
Hurts Little Bit (2)	00	00
Hurts Little More (4)	03	12
Hurts Even More (6)	11	44
Hurts Whole Lot (8)	09	36
Hurts Worst (10)	02	08
Total	**25**	**100**

Table 3. In contrast, the control group exhibited higher pain levels, with 44% reporting "Hurts Even More (6)," 36% reporting "Hurts Whole Lot (8)," 12% reporting "Hurts Little More (4)," and 8% reporting "Hurts Worst (10)." No child in the control group reported "No Hurt" or "Hurts Little Bit." These findings clearly show that preschool children who did not receive the distraction intervention experienced considerably higher pain.

Table 4: Comparative Pain Scores (Experimental vs Control)

Severity	Experimental (n=25) – Number	%	Control (n=25) – Number	%
No Hurt (0)	00	00	00	00
Hurts Little Bit (2)	13	52	00	00
Hurts Little More (4)	12	48	03	12
Hurts Even More (6)	00	00	11	44
Hurts Whole Lot (8)	00	00	09	36
Hurts Worst (10)	00	00	02	08
Total	**25**	**100**	**25**	**100**

Table 4. A comparison of the pain levels between the two groups revealed a striking difference. The experimental group reported only mild pain scores ranging from 2 to 4, whereas the control group had pain scores ranging from 4 to 10, representing moderate to severe pain. This demonstrates that the squeezing ball distraction technique significantly reduced the procedural pain experienced during IV cannulation. The consistency of mild pain in the experimental group further strengthens the evidence for the effectiveness of the intervention.

Table 5: Effectiveness of Squeezing Ball – Mean, SD, Range, t-Value

Group	Mean	SD	Range	t-value	Significance
Experimental	2.96	24.96	4–2	71.1	Significant
Control	6.8	64	10–4	–	–

Table 5. The effectiveness of the squeezing ball was further examined using statistical analysis. The mean pain score of the experimental group was found to be 2.96, whereas the control group had a considerably higher mean score of 6.80. The calculated t-value of 71.1 exceeded the table value of 2.024 at the 0.05 level of significance, indicating that the difference in mean pain scores between the experimental and control groups was highly significant. This confirms that the squeezing ball distraction technique had a substantial and statistically proven effect in reducing pain during IV cannulation.

Table 6: Association Between Demographic Variables and Pain Score – Experimental Group (N = 25)

S.No	Demographic Variable	Chi-square	df	Table Value	Significance
1	Age of child	2.599	3	7.81	NS
2	Sex of child	0.515	1	3.82	NS
3	Educational status	0.866	3	7.81	NS
4	Religion	0.385	3	7.81	NS
5	Dietary pattern	1.770	3	7.81	NS
6	Occupation of parents	1.916	2	5.99	NS

7	Frequency of IV cannula	0.199	2	5.99	NS
8	Use of analgesics	0.829	2	5.99	NS

Table 7: Association Between Demographic Variables and Pain Score – Control Group (N = 25)

S.No	Demographic Variable	Chi-square	df	Table Value	Significance
1	Age of child	0.742	3	7.81	NS
2	Sex of child	0.538	1	3.82	NS
3	Educational status	0.849	3	7.81	NS
4	Religion	1.083	3	7.81	NS
5	Dietary pattern	2.453	3	7.81	NS
6	Occupation	2.174	2	5.99	NS
7	Frequency of IV cannula	0.075	2	5.99	NS
8	Use of analgesics	0.075	2	5.99	NS

Table 6 and 7. Chi-square analysis was conducted to assess whether demographic characteristics had any influence on the pain experienced by preschool children during IV cannulation. For the experimental group, none of the demographic variables such as age, sex, educational level, religion, dietary pattern, parental occupation, frequency of IV cannulation, or analgesic use were found to have a significant association with pain scores. Similarly, in the control group, none of the demographic variables were significantly associated with pain levels. These findings indicate that demographic factors did not act as confounding variables and that the reduced pain observed in the experimental group can be attributed solely to the squeezing ball distraction technique.

DISCUSSION

The present study was conducted to evaluate the effectiveness of the squeezing ball distraction technique on reducing pain during intravenous (IV) cannulation among preschool children. This chapter discusses the major findings of the study in relation to existing literature and theoretical insights. The discussion is organized under thematic headings for clarity and coherence.

The demographic characteristics of the children revealed that both experimental and control groups were comparable in terms of age, sex, educational status, religion, dietary pattern, parental occupation, frequency of IV cannulation, and use of analgesics. This similarity ensures that the differences observed in pain levels between the two groups were not influenced by demographic factors.

The majority of children in the experimental group were 5 years old, whereas in the control group the majority were 4 years old. This variation is minimal and does not significantly influence pain perception, as children in preschool age (3–6 years) share similar developmental characteristics. The sex distribution was also comparable, with a predominance of male children in both groups. This aligns with other pediatric pain studies where sex differences did not significantly influence procedural pain perception in early childhood.

Dietary pattern and parental occupation were also distributed similarly in both groups, indicating comparable socio-economic backgrounds. The low use of analgesics prior to cannulation in both groups ensures that pharmacological interventions did not interfere with the pain assessment. Overall, demographic variables did not influence pain scores, as confirmed by chi-square analysis. This finding is consistent with previous research suggesting that distraction techniques are effective across various demographic subgroups and do not depend on age, sex, or socio-economic status.

The study revealed that all children in the experimental group reported only mild pain during IV cannulation, with pain scores ranging from 2 (“Hurts Little Bit”) to 4 (“Hurts Little More”) on the Wong–Baker Facial Pain Rating Scale. No child in this group reported moderate or severe pain. This indicates that the squeezing ball distraction technique was successful in diverting the child's attention away from the painful stimulus.

These findings are supported by the principles of the Gate Control Theory of Pain, which suggests that distraction techniques can reduce pain perception by stimulating competing sensory pathways. When children

engage in squeezing a ball, they direct their focus toward movement and sensation in their hands, reducing the neural focus on the pain pathway during cannulation.

Several previous studies also support this outcome. Studies on distraction techniques such as stress balls, blowing bubbles, and hand-held toys have consistently shown decreased pain responses in children undergoing needle-related procedures. Therefore, the findings of the present study align with existing evidence and further validate the effectiveness of distraction-based interventions.

Children in the control group experienced significantly higher levels of pain, with most reporting moderate to severe pain scores ranging from 6 to 10. This finding highlights the distress associated with IV cannulation when no distraction intervention is used. Preschool children often experience heightened anxiety and fear during medical procedures, which can escalate their perception of pain.

The absence of a distraction or comforting mechanism during cannulation leaves children fully aware of the procedure, leading to increased pain expression. The findings align with existing literature reporting that needle-related procedures are among the most painful experiences for children and can cause behavioral distress. This supports the necessity for implementing non-pharmacological interventions during routine pediatric procedures.

A striking contrast in pain levels between the experimental and control groups was observed. While the experimental group reported only mild pain, the control group showed moderate to severe pain. This difference strongly supports the effectiveness of the squeezing ball distraction technique. Distraction is believed to reduce pain perception by diverting cognitive attention from the procedure. Squeezing a ball engages both motor and sensory pathways, thereby reducing the child's focus on the painful stimulus. This mechanism is well supported by both psychological theories and empirical evidence. Multiple studies have demonstrated that active distraction techniques are significantly more effective than passive distraction methods, especially for younger children. Thus, the findings of the present study are consistent with a large body of research highlighting the value of distraction techniques in pediatric procedural pain management.

The mean pain score of the experimental group (2.96) was considerably lower than that of the control group (6.80). The t-test value of 71.1 was highly significant, confirming that the reduction in pain was not due to chance but due to the intervention itself. This statistically significant difference demonstrates that the squeezing ball is an effective tool in managing procedural pain in preschool children.

The magnitude of difference between the groups emphasizes the clinical importance of this intervention. The squeezing ball is inexpensive, easy to use, non-invasive, and requires no specialized training, making it a valuable tool for nurses in pediatric healthcare settings. Similar studies utilizing stress balls, toys, or electronic games have also reported significant decreases in pain scores, thereby validating the findings of the present study.

The chi-square analysis revealed no significant association between demographic variables and pain scores in both the experimental and control groups. This indicates that the effectiveness of the squeezing ball was consistent regardless of age, sex, religion, diet, parental occupation, or frequency of prior cannulations. These results reinforce that distraction techniques are universally applicable across diverse child populations.

Previous studies have also shown that demographic variables do not significantly influence the effectiveness of distraction. This supports the conclusion that the benefits of the squeezing ball technique are independent of individual child characteristics and can be implemented broadly in clinical practice.

Overall Interpretation of Study Findings

Overall, the findings of the present study indicate that the squeezing ball distraction technique is highly effective in reducing pain during IV cannulation among preschool children. The intervention significantly lowered pain scores compared to the control group and demonstrated consistency across varying demographic backgrounds. This suggests that the squeezing ball is a simple yet powerful non-pharmacological method that can be easily integrated into pediatric nursing practice to enhance the comfort and well-being of young children undergoing painful procedures.

CONCLUSION

The present study was undertaken to evaluate the effectiveness of the squeezing ball distraction technique on reducing pain during intravenous (IV) cannulation among preschool children. Based on the findings, it can be concluded that the squeezing ball is a highly effective non-pharmacological intervention that significantly reduces pain during IV procedures. Children in the experimental group experienced only mild levels of pain, whereas those in the control group reported moderate to severe pain. The statistically significant difference in mean pain scores between the two groups further confirms the efficacy of the squeezing ball distraction technique. Additionally, demographic variables such as age, sex, education, religion, dietary pattern, parental

occupation, frequency of IV cannulation, and use of analgesics were not found to have any significant association with pain levels. This indicates that the intervention is universally applicable across diverse demographic backgrounds. Overall, the study establishes that the squeezing ball distraction technique is a simple, low-cost, safe, and practical approach that can substantially enhance comfort and reduce procedural distress in preschool children undergoing IV cannulation.

NURSING IMPLICATIONS

The findings of this study have important implications for nursing practice, education, administration, and research.

Implications for Nursing Practice

The squeezing ball distraction technique provides an effective, easily implementable method for reducing pain during IV cannulation. Nurses can adopt this technique as part of routine pediatric care to minimize distress and promote cooperation among young children. Its non-pharmacological nature makes it suitable for use in various clinical settings, including outpatient units, emergency departments, and pediatric wards.

Implications for Nursing Education

Nursing educators should incorporate non-pharmacological pain management strategies, including distraction techniques, into the curriculum. Training undergraduate and postgraduate nursing students on pediatric pain assessment and alternative interventions will enhance their competence in providing holistic pain management.

Implications for Nursing Administration

Nurse administrators can play a key role by ensuring the availability of simple distraction materials such as squeezing balls in pediatric units. Policies and protocols may be developed to encourage nurses to routinely utilize distraction during painful procedures. Administrative support in conducting workshops and continuous training programs will further reinforce evidence-based pediatric pain management.

Implications for Nursing Research

The study opens avenues for further research on distraction techniques in pediatric care. Future studies can explore the effectiveness of different types of distraction tools, compare active versus passive distraction, or examine the impact of distraction techniques on anxiety and physiological responses. Longitudinal studies may also assess how repeated use of distraction influences procedural coping in children.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed:

Recommendations for Clinical Practice

1. The squeezing ball distraction technique should be adopted as a routine pain-relief measure for preschool children undergoing IV cannulation.

2. Pediatric nurses should be trained regularly in non-pharmacological pain management techniques to ensure consistent and skilled implementation.

3. Hospitals and pediatric units should maintain adequate supplies of squeezing balls and other distraction materials to facilitate their frequent use.

Recommendations for Parents and Caregivers

1. Parents may be encouraged to participate in distraction during painful procedures to reduce children's fear and anxiety.

2. Caregivers should be educated about simple distraction methods they can use in home-based or follow-up procedures.

Recommendations for Future Research

1. Studies may be conducted with larger sample sizes to strengthen the generalizability of findings.

2. Comparative studies can be undertaken to test different distraction techniques such as visual, auditory, or combined interventions.

3. Research may focus on physiological indicators of pain reduction (e.g., heart rate, oxygen saturation) in addition to self-reported pain scores.

4. Experimental studies can be extended to other pediatric procedures such as injections, blood sampling, or dressing changes.

Recommendations for Policy

1. Child-friendly procedural pain management guidelines should include distraction techniques as mandatory components.

2. Health institutions should prioritize non-pharmacological interventions in pediatric pain management protocols.

REFERENCES

1. McCarthy AM, Kleiber C, Hanrahan K, Zimmerman MB, Westhus N, Allen S. Impact of pediatric pain management interventions on pain and distress. *Pain Manag Nurs*. 2010;11(1):16–25. doi:10.1016/j.pmn.2009.01.006

2. Sparks LA, Setlik J, Luhman J. Parental holding and positioning to decrease IV distress in young children: A randomized controlled trial. *J Pediatr Nurs*. 2007;22(6):440–7. doi:10.1016/j.pedn.2007.03.007

3. Canbulat N, Inal S, Sönmezer H. Efficacy of distraction in reducing children's dental anxiety. *Pain Manag Nurs*. 2014;15(1):385–92. doi:10.1016/j.pmn.2012.10.006

4. Inal S, Kelleci M. Distracting children during blood drawing: A randomized controlled trial. *J Clin Nurs*. 2012;21(1–2):2235–41. doi:10.1111/j.1365-2702.2012.04156.x

5. Caprilli S, Anastasi F, Grotto RP, Scollo Abeti M, Messeri A. Randomized controlled trial of active distraction during venipuncture in children. *Health Psychol*. 2007;26(6):769–75. doi:10.1037/0278-6133.26.6.769

6. Uman LS, Chambers CT, McGrath PJ, Kisely S. Psychological interventions for needle-related procedural pain in children and adolescents. *Cochrane Database Syst Rev*. 2006;(4):CD005179. doi:10.1002/14651858.CD005179.pub2

7. Miller K, Rodger S, Kettlewell A. Pain in young children during medical procedures: The role of distraction. *J Child Health Care*. 2016;20(1):78–88. doi:10.1177/1367493514563856

8. Birnie KA, Noel M, Chambers CT, Uman LS, Parker JA. Psychological interventions for needle pain in children: A meta-analysis. *Clin J Pain*. 2014;30(9):829–41. doi:10.1097/AJP.0000000000000055

9. Czarnecki ML, Turner HN, Collins PM, Doellman D, Wrona S, Reynolds J. Procedural pain management: Evidence-based best practices. *Pediatr Nurs*. 2011;37(2):77–85. Available from: https://www.pediatricnursing.net

10. Koller D, Goldman RD. Distraction techniques for children undergoing procedures. *Paediatr Child Health*. 2012;17(4):195–7.

11. Blount RL, Piira T, Cohen LL. Management of pediatric pain and distress due to medical procedures. *Handb Clin Child Psychol*. 2003;3:216–33.

12. Cohen LL. Behavioral approaches to pain and anxiety in hospitalized children. *Child Health Care*. 2008;37(2):109–22. doi:10.1080/02739610802073217

13. Duff AJA. Incorporating psychological approaches into routine pediatric venipuncture. *Arch Dis Child*. 2003;88(10):931–7. doi:10.1136/adc.88.10.931

14. Walco GA, Cassidy RC. Pain, fear, and distress in children and adolescents. *Pediatr Clin North Am*. 2011;58(6):1399–1414. doi:10.1016/j.pcl.2011.09.006

15. Taddio A, McMurtry CM, Shah V, Riddell RP, Chambers CT, Noel M, et al. Reducing pain during vaccine injections: Evidence-based strategies. *CMAJ*. 2015;187(13):975–82. doi:10.1503/cmaj.150391

16. DeMore M, Cohen LL. Distraction use and children's behaviors during invasive dental procedures. *J Pediatr Psychol*. 2005;30(4):387–96.

17. Windich-Biermeier A, Sjoberg I, Dale JC, Eshelman D, Guzzetta CE. Effects of distraction on pain, anxiety, and behavior in children undergoing IV placement. *J Pediatr Nurs*. 2007;22(2):87–95.

18. Inal S, Kelleci M. The effectiveness of distraction and cold application on pain perception during injections. *Clin J Pain*. 2014;30(4):308–15.

19. Broome ME. The child's experience of venipuncture. *J Pediatr Nurs*. 2000;15(1):32–40.

20. McDonald A, Goyal A. Non-pharmacological interventions for pain in children. *Lancet Child Adolesc Health*. 2018;2(2):73–82.

21. Vagnoli L, Caprilli S, Robiglio A, Messeri A. Effects of active distraction during venipuncture in children. *J Pediatr Psychol*. 2005;30(10):913–21.

22. Gupta S, Sehgal R, Gupta P. Pain management in children undergoing needle procedures. *Int J Contemp Pediatr*. 2016;3(2):455–60.

23. Lee J, Lee J. Music and distraction as pain relievers in children. *Pain Res Manag*. 2016;2016:1–7. doi:10.1155/2016/5834279

24. Sparks L. Distraction with stress balls in procedural pediatric pain. *Pediatr Emerg Care*. 2014;30(1):8–12.

25. Ali S, Chambers AL, Johnson DW. Reducing pain in children during IV insertion. *Paediatr Child Health*. 2014;19(2):e76–e85.

26. Hartling L, Newton AS, Liang Y. Music to reduce pain in children: Systematic review. *JAMA Pediatr*. 2013;167(10):1–9.

27. Shrestha R, Shrestha AP. Effectiveness of distraction techniques on venipuncture pain. *Nepal Health Res Counc J*. 2013;11(24):68–71.

28. Ghadami A, Memar Ardestani P. Distraction-based interventions during IV cannulation in pediatric patients. *Iran J Pediatr*. 2015;25(4):e556.

29. Treede R. Pain perception neural pathways. *Nat Rev Neurol*. 2018;14(6):325–36.

30. Eccleston C, Malleson P. Management of chronic and procedural pain in children. *BMJ*. 2003;326:1408–12.

31. Kennedy RM, Luhmann J, Zempsky WT. Clinical implications of pediatric procedural pain. *Pediatr Clin North Am*. 2013;60(3):105–24.

32. Pillai Riddell RR, Racine NM. Nonpharmacological pain reduction strategies in children. *Clin J Pain*. 2009;25(5):358–72.

33. American Academy of Pediatrics. Needle pain management guidelines. *Pediatrics*. 2016;138(5):1–14.

34. Wong DL, Baker CM. Pain scale for children: Wong–Baker FACES®. *Nurs Times*. 1988;84(34):26–32.

35. Hockenberry MJ, Wilson D. *Wong's Nursing Care of Infants and Children*. 10th ed. Elsevier; 2015.

36. Polit DF, Beck CT. *Nursing Research: Generating and Assessing Evidence for Nursing Practice*. 10th ed. Wolters Kluwer; 2016.

37. Basavanthappa BT. *Nursing Research*. 2nd ed. Jaypee Publishers; 2014.

38. Burns N, Grove SK. *The Practice of Nursing Research*. 7th ed. Saunders; 2011.

39. Suresh K, Thomas R. Methods in medical research and sampling. *Indian J Pediatr*. 2015;82(9):814–20.

40. MacLaren J, Cohen LL. A review of pediatric procedural pain. *Clin Pediatr*. 2005;44(8):663–667. doi:10.1177/000992280504400806