The Effect of Distracting Lighting and Moving Musical Toys on Pain Levels During Blood Collection in Preschool-Age Children

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OPEN ACCESS

Proceeding STIKep PPNI Jawa Barat

Website :
https://proceedings.stikep-ppnijabar.ac.id/index.php/psj

Volume 1 (1), 9-16

Article info
Received : December 28, 2024
Revised : April 22, 2025
Accepted : May 02, 2025
Published : May 19, 2025

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Citation
Hendra, A., & Maelani, L. (2025). The effect of distracting lighting and moving musical toys on pain levels during blood collection in preschool-age children. *Proceeding STIKep PPNI Jawa Barat,* 1(1), 9-16.

Abstract

Objective: To evaluate the impact of lighted and moving musical toys as a distraction technique on pain levels during blood collection in preschool-aged children.
Method: This study utilized a quasi-experimental post-test design with two groups. A convenience sampling method was applied to select 80 participants, with 40 assigned to the control group and 40 to the intervention group. The intervention group experienced distraction through lighted and moving musical toys for 5-10 minutes during the blood collection procedure. Pain levels were measured using the Wong-Baker Faces Pain Rating Scale. Data analysis included independent t-tests, ANOVA, and Pearson correlation tests.
Results: There was a significant difference in pain scores between the control and intervention groups during blood collection, with a Sig (2-tailed) value of 0.0001 ($p < 0.005$).
Conclusion: The use of lighted and moving musical toys as a distraction technique significantly reduced pain during blood collection in preschool-aged children. This approach provides an effective alternative for pain management in pediatric care settings.

Keywords: Preschool children, Distraction, Toys, Pain, Blood sampling

INTRODUCTION

In preschool-age children, the procedure to draw blood is noteworthy for its fearfulness and significant pain. A study by (S. Walther-Larsen et al., 2016). found that of 570 patients,213 experienced pain within the first 24 hours of treatment with the invasive method of blood sampling attributing to 36% as a source for children treated. In preschool children, taking blood causes moderate pain in 40% of the children and severe pain in 60% (Yahia Mohamed Sayed et al., 2020). Alterations in behavior as well as changes in physiologic parameters are the established responses of a child to its pain 26. Behavioral changes: grimacing, crying, screaming, hitting, attempting to remove stimulus from the body, and moaning (Hajar, 2013). Notably elevated vital signs such as pulse rate, blood pressure, and respiratory rate, as well as physiological changes such as pallor, diaphoresis, and pupil dilation (Berman et al., 2016).

Observation results in one of the pediatric inpatient rooms at Dr. Hasan Sadikin pointed out that pain management during blood collection is still very limited. Nurses usually ask parents to accompany and hug the child when a blood draw is being carried out, in the hope that

the parent's presence can provide a little comfort to the child. However, pain management involving parents alone is still not able to reduce pain when taking blood. This can be seen from the increase in heart rate and the child struggling when blood is taken. In fact, because of their fear, it is not uncommon for children to start crying when the nurse approaches the child.

When preschool children experience pain and it is not resolved, there will be a release of stress hormones which can worsen the condition, hinder healing, and prolong hospitalization time. Repeated exposure to pain can result in hypersensitivity to pain until age (Ruth E. Grunau et al., 2006) the experience of feeling pain can also cause trauma to children. This trauma then makes the child increasingly uncooperative when medical procedures are carried out (Mehmet Alperen Turgut & Ayşe Sonay Türkmen, 2023). This is in sharp contrast to the principle of atraumatic care for children. Therefore, it is important to find ways to reduce the pain felt by children during blood collection procedures. A review of the literature shows that distraction is the main technique that is often used to reduce pain in children during blood collection procedures. The distractions or diversions used during blood collection vary greatly, including listening to music, watching videos, picture story books, and toys (Budiarti et al., n.d.). Regarding the various media used, the use of toys is considered the most appropriate for preschool-age children because children are always actively holding toys and can play with toys as they wish.

Research conducted by Mehmet Alperen Turgut & Ayşe Sonay Türkmen, 2023 demonstrated that using lighted toys as a distraction significantly reduced pain and fear levels in children aged 3–6 years during blood draws. In another study, the same authors investigated the use of toys that produce sounds and movements as a distraction for children aged 4–6 years during invasive procedures. While the results showed no significant differences in overall levels of fear and pain between the control and intervention groups, significant differences were observed in specific pain parameters, such as crying and heart rate (Mehmet Alperen Turgut & Ayşe Sonay Türkmen, 2023)

The blood collection process can lead to considerable pain and stress among preschool children. Children express pain via common behaviors such as crying, screaming, hitting, pushing the stimulus away, and moaning (Hajar, 2013). Pain will make the stress hormones release constantly which will imply a worsened condition, and the healing process may take a longer period and long duration in the hospital. Conversely, pain can be traumatic, and children become all the less compliant through a lifetime of medical care—an effect that may endure into adulthood (Alperen, 2023; Gardner et al., 2016). This outcome sharply contrasts with the principles of atraumatic care for children, which aim to minimize physical and emotional distress. Thus, finding effective strategies to reduce pain during blood collection is essential to improving the overall experience and outcomes for young patients.

Research by Karaca and Guner examined the use of sound- and motion-based toys as a distraction for children aged 4–6 years during invasive procedures. The results indicated no significant differences in overall fear and pain levels between the control and intervention groups. However, significant differences were observed in specific pain-related parameters, such as crying and heart rate (Alperen, 2023; Karaca & Guner, 2021).

While previous studies have explored the use of toys (including lighted and sound-producing toys) as a distraction for children during painful procedures, there appears to be insufficient research specifically examining the combined effect of musical toys and lighting on reducing pain and fear during blood collection in preschool children. Although some studies have reported partial benefits, such as changes in heart rate and crying, there is a lack of comprehensive evidence on how this specific combination impacts the overall pain experience in this age group.

Therefore, in this situation, this study will introduce having musical toys and lighting carrying out the blood collection on preschool

children and their pain levels. Current research of this nature is especially relevant as the results may guide medical staff and parents on the use of such techniques for reducing pain and stress associated with medical examinations and procedures for infants. Similarly, an enriched knowledge of the effect of musical toys and lighting may improve children's medical experiences in hospitals, promote better practice care habits, and prevent illness-related trauma at an early age.

METHODS

Study Design

This research employs a quantitative approach using a quasi-experimental two-group post-test design to compare the effects of an intervention (musical and lighting toys) on the pain levels of preschool-aged children undergoing blood collection procedures. The study follows a parallel trial design, where one group (control) receives only standard care, while the other group (intervention) is exposed to musical and lighting toys during the procedure. The research was conducted in the pediatric inpatient units at RSUP Dr. Hasan Sadikin Bandung from December 2023 to January 2024, specifically in the HCU Asnawati, Kelangna 1, Kelangna 2, and second-floor Pediatric Surgery Ward. These units cater to third-class pediatric patients.

Sample

The population for this study comprises preschool-aged children undergoing blood collection procedures in the designated pediatric wards during the study period. A total of 80 participants were included in the sample, with 40 in the control group and 40 in the intervention group. The inclusion criteria included preschool-aged children, aged 3–6 years, who were undergoing blood collection procedures and whose parents or guardians provided informed consent. Children with severe medical conditions or cognitive impairments that could affect their pain perception were excluded from the study.

Instrument

Pain levels were measured using the Wong-Baker Faces Pain Rating Scale, developed by Donnie Wong and Connie Baker in 1983. The scale was designed to help children express their pain more easily, as many found numerical ratings difficult to use. It consists of 10 face items, ranging from a happy or smiling face indicating "no pain" to a sad or crying face representing the "worst possible pain." The scale's scores range from 0 to 10, with higher scores indicating greater pain intensity. To ensure an unbiased and consistent assessment, the scale was presented in its original format without words such as "happy" or "sad," allowing children to point to the face that most closely resembled their pain experience. The Wong-Baker Faces Pain Rating Scale has been validated for use across various populations and demonstrates good reliability and consistency when children rate their pain. It also correlates well with other pain assessment tools, such as the Visual Analog Scale (VAS) (Garra et al., 2013).

Data Collection

The intervention in this study involved introducing musical and lighting toys to the intervention group during the blood collection procedure. These toys were designed to provide sensory distraction, aiming to reduce the children's perception of pain and anxiety during the procedure. The toys were activated during the procedure to engage the children's attention, thereby potentially diverting their focus from the discomfort of the blood collection. In contrast, the control group received standard care, which followed the usual hospital practices for blood collection without any additional interventions like the use of toys or other distractions.

Pain levels were assessed immediately following the procedure using the Wong-Baker Faces Pain Rating Scale, a widely used tool for assessing pain in children. This scale allows children to express their pain levels by selecting a face that best represents how they feel, ranging from a happy face for no pain to a crying face for the worst pain. To ensure the reliability and comparability of the data, the data collection process was standardized across both groups. This meant that both the intervention and control groups were assessed using the same methods and at the same points in time,

minimizing potential bias and ensuring consistency in the measurement of pain levels.

Data Analysis

A systematic approach was used for data analysis in this study. The Shapiro-Wilk test was applied when the sample size was less than 60, while the Kolmogorov-Smirnov test was used for larger sample sizes to assess normality. An independent t-test was conducted for hypothesis testing to compare mean pain scores between the groups. Additionally, bivariate analysis with ANOVA was employed to account for potential confounding variables when comparing pain scores between the groups. If the p-value was greater than 0.05, the data were considered normally distributed, justifying the use of parametric statistical tests.

Ethical Considerations

The study performed adheres to the ethical principles and has received approval for research ethics from the institutional ethics review board. Informed consent was obtained (written form from the parents or guardians, and verbal assent from children). Names and other identifiers were not recorded to protect the confidentiality of participants, data were collected solely for research purposes. Participation was completely voluntary, and participants were informed of their right to withdraw from the study at any time with no negative consequences.

RESULTS

Table 1 Characteristics of Patients Undergoing Blood Collection (N=80)

Characteristic	Control (n=40) (%)	Intervention (n=40) (%)	P-value
Age (years)			
Mean ± (SD)	4.43 ± 1.10	4.83 ± 1.21	0.128[a]
Median	4	5	
Min-Max	3-6	3-6	
Gender			0.906[b]
Male	27 (67.5)	19 (47.5)	
Female	13 (32.5)	21 (52.5)	
Hospitalization Experience			0.988[b]
Ever Hospitalized	37 (92.7)	40 (100)	
Never Hospitalized	3 (7.5)	0 (0)	
Venipuncture Success			0.925[b]
1 Attempt	32 (80)	36 (90)	
2 Attempts	5 (12.5)	4 (10)	
3 Attempts	2 (5)	0 (0)	
4 Attempts	1 (2.5)	0 (0)	
Height (cm)			0.511[a]
Mean ± (SD)	94.2 ± 12.5	95.9 ± 12.7	
Min-Max	64-120	68-120	
Weight (kg)			0.188[a]
Mean ± (SD)	14.04 ± 3.98	13.95 ± 4.75	
Min-Max	7.1-28	6.5-28.7	
Medical Diagnosis			0.169[b]
Respiratory Disease	9 (22.5)	4 (10)	
Renal Disease	5 (12.5)	10 (25)	
Malignancy	20 (50)	16 (40)	
Other Diagnoses	6 (15)	10 (25)	

Description: [a]Independent t-test test results; [b]Chi-Square Test Results

The demographic and clinical characteristics of the control and intervention groups were

assessed for homogeneity. As shown in Table 1, the median age was slightly higher in the intervention group (5 years) compared to the control group (4 years). Gender distribution differed between groups, with males predominating in the control group (67.5%) and females in the intervention group (52.5%). Both groups had a high prevalence of prior treatment history, with 92.5% in the control group and 100% in the intervention group.

In the control group, based on Table 1, the median age was 4 years, with a minimum age of 3 years and a maximum age of 6 years. In the intervention group, the median age was 5 years, with a range of 3 to 6 years. Regarding sex, the majority of patients in the control group were male (67.5%), while in the intervention group, the majority were female (52.5%). Most patients in both groups had a history of previous treatment, with 92.5% in the control group and 100% in the intervention group. Regarding the success rate of the first puncture attempt, 80% of patients in the control group and 90% in the intervention group experienced successful attempts.

For body weight, the average weight in the control group was 14.04 ± 3.98 kg, ranging from 7.1 kg to 28.0 kg. In the intervention group, the average weight was 13.95 ± 4.75 kg, with a range of 6.5 kg to 28.7 kg. Regarding height, the average height in the control group was 94.2 ± 12.5 cm, with a range of 64.0 cm to 120.0 cm. In the intervention group, the average height was 95.9 ± 12.7 cm, with a range of 68.0 cm to 120.0 cm. In terms of medical diagnoses, malignancy (cancer) was the most common diagnosis, with 50% of patients in the control group and 40% in the intervention group.

Homogeneity testing was conducted using the chi-square test for categorical variables (gender, treatment experience, puncture success, and medical diagnosis) and an independent t-test for numerical variables (age, height, and body weight). The results of the homogeneity tests showed p-values> 0.05 for all variables, indicating no statistically significant differences between the two groups. Thus, the control and intervention groups were considered homogeneous with respect to demographic and clinical characteristics.

Table 2 Pain Scale in the Control Group (N=40) and Intervention Group (N=40)

	Control			Intervention		
	Mean ±SD	Min-Max	N (%)	Mean ±SD	Min-Max	N (%)
Post-test	3.1±0.98	2-5		1.65±1.03	0-3	
No Pain			0			8
Mild Pain			25 (62.5)			32 (80)
Moderate pain			15 (37.5)			0

Based on Table 2, the intervention group demonstrated a significantly lower average pain scale value (1.65 ± 1.03) compared to the control group (3.1 ± 0.982) after the intervention, with an average difference of 1.45 between the two groups. Regarding pain severity, 80% of participants in the intervention group reported no pain, while in the control group, 62.5% experienced mild pain. This highlights the effectiveness of the intervention in reducing pain intensity among participants.

Table 3 Analysis of the Relationship Between Respondent Characteristics and Pain Levels

Variable	Mean Diff	t-test	95% CI	p-value
Gender	0.806	3.026	0.27 – 1.33	0.003[a]
Treatment Experience	0.736	1.012	-0.71 – 2.18	0.315[a]
Puncture Success	2.38	6.27	2.1 – 2.65	0.001[b]

Medical Diagnosis	2.38	1.34	2.1 – 2.65	0.268[b]
Age				0.078[c]
Body Weight				0.497[c]
Height				0.151[c]

Based on the analysis, gender and puncture success were found to be significantly associated with pain levels, with p-values of 0.003 and 0.001, respectively. However, there was no significant association between treatment experience, medical diagnosis, age, body weight, and height with pain levels, as the p-values were greater than 0.05.

Table 4 Analysis of the Effect of Musical Toys with Lights and Movement on Pain Levels in Preschool-Aged Children During Blood Collection

Variable	Mean Diff	t-test	95% CI	p-value
Pain				
Post Test	1.45	6.45	1.00 – 1.89	0.000

Table 4 presents the results of the bivariate analysis using an independent t-test, showing a mean difference of 1.45 in post-test pain scores between the intervention and control groups. This difference falls within the 95% Confidence Interval range of 1.00 to 1.89. The p-value of 0.000 ($p < 0.05$) confirms the statistical significance of the findings, leading to the rejection of the null hypothesis (H_0) and acceptance of the alternative hypothesis (H_1).

These results highlight a significant reduction in pain levels among preschool-aged children in the intervention group, demonstrating the effectiveness of musical toys with lights and movement as a therapeutic distraction during blood collection procedures.

DISCUSSION

A recent study evaluated the effectiveness of using light-up and moving musical toys as distraction tools during blood collection procedures for preschool-aged children. The findings demonstrated a significant reduction in pain levels among participants, with a mean difference of 1.45 in pain scores between the control and intervention groups. These results suggest that light-up and moving musical toys serve as an effective distraction, reducing pain during blood collection.

The outcomes align with existing research on distraction techniques in pediatric care. For instance, Turgut and Türkmen (2023) highlighted the benefits of using musical and lighting toys in reducing fear and improving children's coping mechanisms during procedures like venipuncture. Similarly, studies by Karaca and Guner (2022) found that distraction methods, such as cartoon videos and storytelling, resulted in mean differences of 0.97 and 1.50, respectively, in pre-test and post-test scores, indicating their efficacy in managing procedural pain.

Budiarti et al. (2021) demonstrated that incorporating music and video games in pediatric care settings effectively reduced pain intensity and diverted children's attention from discomfort during medical procedures. Similarly, Setiawati (2021) compared distraction methods involving cartoon videos and storytelling, finding both approaches effective, though storytelling yielded a higher mean difference (1.50) than cartoon videos (0.97). Additionally, Ceylan and Erkut (2023) reported that children in a finger puppet distraction group had significantly lower FLACC pain scores compared to those in the control group. These studies collectively highlight the efficacy of various distraction techniques in reducing procedural pain in children.

The findings reveal that gender and the success of venipuncture significantly impact the pain levels experienced during blood collection in children. In contrast, factors such as treatment history, cancer diagnosis category, age, body weight, and height showed no statistically significant effects on pain perception. These results underscore the importance of strategies that enhance procedural success and address gender-specific pain responses in pediatric care. The study aligns with broader research on

gender differences in pain perception. For instance, Abdullah et al. (2021) noted that women tend to have greater sensitivity to experimental noxious stimuli due to differences in nociceptive thresholds and pain-processing mechanisms. This suggests that gender can influence how pain is experienced and reported, even in pediatric populations. Moreover, successful puncture attempts not only reduce immediate pain but also mitigate long-term complications associated with multiple failed attempts. This emphasizes the critical role of healthcare providers in ensuring technical precision and reducing distress during invasive procedures.

This study highlights the significant value of light-up and moving musical toys as a non-invasive and cost-effective method to alleviate pain in preschool-aged children. Implementing such strategies in clinical settings could greatly enhance the overall patient experience and lead to improved procedural outcomes. Nonetheless, the study's focus was confined to preschool-aged children and a single distraction type. Future research is encouraged to investigate the comparative effectiveness of different distraction techniques, including video games, virtual reality, and storytelling, across a wider range of pediatric age groups and clinical contexts.

CONCLUSIONS

This study highlights the efficacy of a light-up and moving musical toy as a distraction technique during blood collection in preschool children. The intervention not only reduced pain levels significantly but also showed potential as a practical, low-cost method for improving pediatric procedural care. Further research could explore other distraction modalities, such as storytelling or interactive games, for broader applications.

Acknowledgment

We would like to express our sincere gratitude to all the participants for their valuable involvement in this study.

Conflict of interest

All authors declare no conflict interest

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