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Implementation of innovation Buzzy on the level of pain during infusion in children with leukemia at RSPAD Gatot Soebroto

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Abstract Children with leukemia undergo prolonged chemotherapy, which often involves painful procedures such as intravenous (IV) insertions. Managing this pain is a critical aspect of their care, with various strategies being employed to reduce discomfort. One innovative method is Buzzy, which combines vibration and cold therapy to alleviate pain. Buzzy activates supraspinal modulation by applying cold stimulation for 30 to 60 seconds, significantly reducing pain perception. This study aimed to examine the impact of Buzzy on pain levels during IV insertions in children with leukemia at RSPAD Gatot Soebroto. A total of 34 respondents participated in the study, selected through purposive sampling. The research employed an experimental design, using independent and paired t tests to analyze the data, with a significance threshold set at $p < 0.05$. The results demonstrated a notable reduction in pain levels after the application of Buzzy. The mean pain scores before and after the intervention showed a statistically significant difference, with a p-value of 0.000, indicating that Buzzy effectively alleviated pain during IV insertions. Beyond pain relief, Buzzy's application offers additional benefits. It helps reduce anxiety and fear in children undergoing invasive procedures, providing psychological comfort for both the patients and their parents. Moreover, this method can address more severe pain, such as postoperative discomfort, by minimizing the intensity of the pain experience. Buzzy represents a promising innovation in pediatric pain management, particularly for children undergoing intensive treatments like chemotherapy. Its ease of use, combined with its significant impact on reducing pain and anxiety, makes it a valuable tool in improving the quality of care for young patients with leukemia. Integrating this device into routine clinical practice can enhance the overall treatment experience for children and their families.

Keywords: buzzy, leukemia, pain management, preschool

1. Introduction

Leukemia, although a rare disease, accounts for one in three cancers in children and adolescents. According to data from the Union for International Center Control (UICC), every year, 176,000 children are diagnosed with cancer. Moreover, as many as 9,000 children have leukemia annually (UUIC, 2015). On the basis of 2016 WHO data, it is estimated that 26,540 children in the United States have leukemia, of which 11,860 die (Fan et al., 2023). According to the Ministry of Health of the Republic of Indonesia, there are approximately 11,000 cases of cancer in children every year, and one-third of childhood cancers are leukemia (Agustina et al., 2018). Children with leukemia undergo a long therapeutic process, that is, by administering chemotherapy. One of the preparations used before chemotherapy is invasive treatment in the form of infusion. This can cause children to experience traumatic pain, anxiety, stress, and fear during treatment. Pain has many physiological, mental, and emotional effects; therefore, pain management during the procedure is critical (Veerman et al., 2022).

According to Valeri (2015), reducing the short- and long-term adverse effects of this traumatic procedure on children is an essential part of nursing for good pain management. The methods used for pain management to reduce the pain experienced by children during invasive procedures are popular. Buzzy sensation is a method developed to reduce pain by combining vibration and cold sensations. This device is shaped like a bee, where the body parts vibrate, and the wings apply cold distraction to the injection area before insertion into the vein (Ballard, 2019). Vibrations generated from Device Buzzy and the useice page can reduce pain signals transmitted from the periphery to the brain by activating nonnoxious stimuli to prevent pain signals. The use of cold stimulation for 30 or 60 s activates supraspinal modulation, which results in a decrease in pain (Cho et al., 2022).

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The device usage method used in this study differs from device buzz, which is widely used, especially in the United States. Researchers modify and utilize items that are less meaningful to create devices that are buzzy and similar to existing devices. Researchers collaborate with tailors to use materials that do not reduce vibrations in the tool buzzy. This study aimed to determine the effect of implementing buzzy innovation on the level of pain during infusion in children with leukemia at the Gatot Soebroto Army Hospital.

Preschoolers are children between 3 and 6 years old. At this time, children like to imagine and believe that they have power. At preschool age, children build control of their body systems, such as the ability to go to the toilet, dress, and eat by themselves (Chashchin et al., 2017). The emotional characteristics of preschoolers are that they tend to express their emotions freely and openly. Anger is often observed in children at that age, and envy often occurs. Musa (2020) explained that the concept of illness begins during the preschool period and that cognitive abilities begin at the preoperational stage. Preschoolers are children aged 3--6 years; at this age, they find it difficult to distinguish between themselves and the outside world. Their thinking focuses on external events that are experienced.

A buzzy system is a vibration box with a modification that has an ice pack on the back. This tool can reduce pain from sharp objects such as sticks, syringes, and stings. Buzzy control combines the theory of gate control and descending noxious inhibitory control (DNIC) to reduce pain by giving orders to the brain to close the pain signal gate due to the influence of existing vibrations. Simultaneously, the body increases the pain threshold by being exposed to high cold temperatures (Smith, 2021).

DNIC theory explains that an effective pain control mechanism is the ability of the brain to reduce unwanted signals due to vibrations or coldness in parts of the body. This happens when the local control gate confuses the nerves where pain occurs. This theory is similar to when a minor burn occurs; the steps taken are to flow cold water to stop the pain or rub a bumped elbow to stop the pain (Koh et al., 2020). This stimulus simultaneously stimulates vibrations and receptors to relieve pain (Boonarkart et al., 2017). The strong sensation of ice does not allow the brain room to experience sharp pain. The procedure for using Buzzy is as follows: Place the wider end of Buzzy closest to the pain (Buzzy's head is closer to the patient during the procedure), Place Buzzy on the puncture area before the procedure for 30 seconds, press the on button at a distance of 2–5 cm from the proximal direction of the injection site during the procedure for 30 seconds, and press the on button. Evaluation of pain levels in children (Panwar et al., 2021).

The International Association for Study of Pain (IASP) defines pain as an unpleasant subjective sensory and emotional experience associated with actual or potential tissue damage or described in terms of the condition of the damage. Pain is an unpleasant sensory and emotional experience localized to a part of the body where the body tissue feels stabbed, burned, and twisted, such as emotions, feelings of fear, and nausea (Khoshghadm et al., 2021). Pain measurement with the face, legs, activity, crying, and consolability (FLACC). Pain measurement, according to (Şıktaş & Uysal, 2022), is suitable for use at the age of 2–7 years. This scale consists of five assessments, with total scores of 0 (no pain) and 10 (severe pain). The behavioral scores were 0 (relaxed and comfortable) and 1–3 (mild pain/mild discomfort, 4–6 moderate pain, 7–10 severe pain/severe discomfort).

2. Materials and methods

2.1. Study Design and Settings

This study used an experimental one-group pretest–posttest design. The location of the study was Gatot Soebroto Hospital, which is located specifically in the pediatric care unit and is undergoing chemotherapy. Measurements were carried out in two stages, namely, before and after chemotherapy infusion. This design was chosen with the aim of evaluating the effect of chemotherapy on pain levels in children diagnosed with leukemia via the FLACC scale. The study lasted for three months, from January to March 2023.

2.2. Study participants and selection

The participants in this study consisted of preschool-aged children who had been diagnosed with leukemia and were being treated at Gatot Soebroto Hospital. The sampling technique used was purposive sampling, with inclusion criteria including toddlers and preschoolers (2–5 years), children who had been diagnosed with leukemia, and children who would receive intravenous infusion for their first chemotherapy. Children in adequate physical condition were also selected to participate in the study. Among the total population of 66 children, 34 met the inclusion criteria and were willing to become research respondents. Children with comorbid severe conditions that could affect pain assessment were excluded from this study.

2.3. Research instruments

The primary tool used for data collection in this study was the FLACC scale (Face, Legs, Activity, Cry, Consolability), which is a pain measurement scale for children. The FLACC scale measures pain on the basis of five observed parameters: facial expression (Face), leg movement or activity (Legs), level of activity or body movement (Activity), intensity of crying (Cry), and the child's ability to be soothed (Consolability). Each category is scored from 0 to 2 so that the total score ranges from 0 to 10,

where a higher score indicates a higher level of pain. Measurements were taken at two stages, namely, before the first infusion was given (pretest) and after the infusion procedure was completed (posttest).

2.4. Statistical analysis

The statistical analysis used in this study was the dependent t test or paired t test, which aims to compare the average level of pain before and after the infusion procedure in the same group (Lameky & Nugroho, 2024). This test was chosen because the data obtained came from measurements taken at two different times in the same group of participants. The significance level used was $\alpha = 0.05$ to determine whether there was a significant difference in pain levels before and after chemotherapy infusion. The data were analyzed via SPSS version 25. In addition, descriptive analysis was performed to describe the demographic characteristics of the participants, including age, sex, and distribution of pain scores at both measurement times.

2.5. Ethical Consideration

This study received approval from the Research Ethics Committee of the Faculty of Medicine, University of Indonesia, with decree number No. 326/UN2.F1/ETIK/PPM.00.02/2022. Before the study began, informed consent was obtained from the parents or legal guardians of the children who were participants. They explained the purpose, procedures, benefits, and potential risks of this study. The study was conducted while respecting the rights of participants, maintaining the confidentiality of personal data, and preventing unnecessary harm. Participation in this study was voluntary, and participants were allowed to withdraw at any time without any consequences.

3. Results

Table 1 shows that of the 34 respondents, three years (32.4%) of age were the most common. Moreover, for the characteristics of the children according to sex, the majority of the children were female (67.6%).

Table 2 shows that, according to the results of the statistical tests, the average pain level after the intervention decreased to 1.74, with a standard deviation of 1.54. The mean pain level before and after the intervention differed. The statistical test results obtained a value of 0.000, and it can be concluded that there is a significant difference or influence in the application of buzziness to the level of pain when an IV is installed in children with leukemia at the Gatot Soebroto Army Hospital.

Table 1 IDistribution of Respondent Characteristics Based on Age and Gender of Children at RSPAD Gatot Soebroto, 2024.

Variable	Number (n)	%
Child Age		
3 years	11	32.4
4 years	9	26.5
5 years	8	23.5
6 years	6	17.6
Total	34	100
Child's Gender		
Man	11	32.4
Woman	23	67.6
Total	34	100

Table 2 Average pain level before and after the CI implementation intervention at Gatot Soebroto Army Hospital, 2024.

Variable	Mean	SD	SE	p value	n
Pain Level (Pretest)	4.18	0.99	0.17	0.000	34
Pain Level (Posttest)	1.74	1.54	0.26		34

4. Discussion

The results of the study revealed that the majority of the respondents were three-year-old children who were in the preschool stage. Cho et al. (2019) reported that children aged 5--10 years did not exhibit significant differences in pain response. However, a child's age is an essential factor in pain perception because children at different stages of development respond to pain in different ways. At preschool age (3–6 years), children often imagine having superpowers, and their perception of pain is often based on past experiences and limited cognitive capacity. Previous pain experiences can affect how children react to new pain, requiring more effective treatment to divert their attention from pain (Semerci, 2020).

Bourdier et al. (2019) support the effectiveness of a built-up device in young children, especially those under the age of seven. This device works by providing a cold sensation and vibration that can distract children from the pain they are experiencing. School-age children, for example, are more focused on the medical procedure being performed, such as IV insertion, than preschool children are, who are more easily distracted. In a physiological context, the cold sensation produced

by buzzy causes vasoconstriction in blood vessels, which helps slow or stop the transmission of pain through nonmyelinated nerve fibers. This mechanism is known as pain gate control, where sensory input from cold sensations closes the pain pathway in the peripheral nervous system (Yılmaz et al., 2017).

Most of the respondents in this study were female, but Ballard et al. (2018) reported that sex did not have a significant effect on pain response. This may be influenced by cultural factors and parenting, where pain perception can vary significantly between individuals, regardless of sex. Children's pain perceptions are also influenced by personal experiences and cultural backgrounds, indicating that pain responses are highly individual and do not always depend on biological variables.

This study also revealed a significant decrease in pain levels before and after the intervention, with a value of 0.000, indicating a substantial effect on pain reduction. These results are in line with the findings of Küçük Alemdar & Yaman Aktaş (2019), who reported that giving vibrations and cold sensations from buzzers during vaccination can reduce pain and anxiety levels in children. Physiologically, cold sensations applied directly to painful areas stimulate tactile receptors in the skin, which then activate large myelin fibers located near the pain receptors. The activation of these large myelin fibers increases the secretion of beta-endorphins, which act as natural analgesics in the body, thereby increasing the pain threshold and reducing the perception of pain (Yılmaz et al., 2020).

From a medical perspective, pain is a complex response involving sensory and emotional nerve pathways. In children, especially during invasive procedures such as IV lines, pain is a significant problem. The use of nonpharmacological methods such as buzzification is very helpful because it can reduce dependence on analgesic drugs that may have side effects. By providing a combination of cold and vibration sensations, buzzy not only affects local pain receptors but also modulates pain transmission through the peripheral nervous system, which makes children feel more comfortable during medical procedures (Cho et al., 2022). Overall, this study confirms the importance of nonpharmacological innovations such as “buzzy-in-pediatric pain management”. This technique can be used not only to reduce pain during invasive procedures but also to reduce anxiety and increase children's comfort during medical procedures effectively.

5. Conclusions

On the basis of the results and discussion of the study, it can be concluded that there was a significant decrease in the level of pain experienced by children with leukemia during infusion at RSPAD Gatot Soebroto after an intervention using nonpharmacological innovations, namely, the buzzy technique. Before the intervention, the average pain level of the respondents was 4.18, whereas after the intervention, the average pain level decreased significantly to 1.74. The use of the buzzy technique has been proven effective in reducing pain during infusion procedures, with a significance value of 0.000, indicating a strong influence between the application of this technique and a decrease in pain levels. These results underscore the importance of a nonpharmacological approach to pain management in children, especially for those undergoing invasive medical procedures such as chemotherapy.

The suggestions in this research are as follows: 1) Further research is expected to determine the most appropriate age group for implementing buzzy innovation. 2) The application of Buzzy's innovation aims not only to reduce pain but also to reduce anxiety and fear for parents and children. 3) Buzzy innovation, not only for invasive procedures, is expected to reduce the intensity of severe pain, such as surgical wound pain.

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Ethical considerations

This research was conducted after the Research Ethics Committee of the Faculty of Medicine, University of Indonesia, issued a research ethics permit letter numbered SK No. 326/UN2.F1/ETIK/PPM.00.02/2022.

Conflict of interest

The authors declare that they have no conflicts of interest.

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