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Effectiveness of the Buzzy Bee device on pain perception during invasive pricks among school age children: An interventional study

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Abstract:

BACKGROUND: Children often develop phobia toward needle pricks and invasive procedures. It is difficult for medical personnel to manage children's pain when they are in the hospital. When it comes to assessing and treating children's discomfort, nurses interact with them the most. The main objective of the study was to evaluate the effectiveness of the Buzzy Bee device on pain perception among children undergoing invasive needle pricks as part of their treatment.

MATERIALS AND METHODS: The study used a quantitative approach with a quasi-experimental design employing simple random sampling. A post-test-only design was used. After obtaining ethical clearance, data collection was done in the pediatric outpatient department and pediatric wards of Sultan Qaboos University Hospital, Muscat, Oman, between February 2020 and August 2021. Faces Pain Rating Scale for children was used to rate the pain during the procedure, which is a standardized tool. Data were analyzed using SPSS version 23. Descriptive and inferential statistical tests were done to analyze the data.

RESULTS: Totally, 120 children along with their parents were interested in the study. After taking appropriate parental consent and children's assent, the participants were recruited by simple random sampling. They were equally divided into 60 in the experimental group and 60 in the control group. The mean age was 8.14 (+/-2.3) in both groups. Among the 120 samples, 63 (52.5%) of them were males and 57 (47.5%) were females. The majority of them had diagnoses like thalassemia, leukemia, and sickle cell and were getting cannulated for blood transfusion therapy. *t*-test shows that 51.7% (31 samples) reported no pain in the experimental group and 33.3% (20 samples) reported only mild pain, whereas in the control group, only 5.0% (3 samples) reported no pain and 21.7% (13 samples) reported mild pain. About 26.7% of the samples reported very much pain as against the 7% who reported very much pain in the interventional group. There was a statistically significant difference in the pain scores between the control group and the experimental group (likelihood ratio test, $P = 0.0001$). The Buzzy Bee method significantly reduced the pain.

CONCLUSION: The introduction of a toy-like, child-friendly device, which works on the mechanism of vibrations and cold application, lessened the pain intensity during the procedure and acted as a good distractive therapy for children.

Keywords:

Analgesia, child, hospitalized, intravenous, pediatrics, pain

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Introduction

Children undergo a number of painful procedures, the most popular being needle pricks like peripheral IV insertions.[1] IV cannulations, obtaining blood specimens, phlebotomy, vaccination, and burn dressing change are painful.[2]

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Anxiety during invasive needle prick procedures has resulted in developing phobia in children. This bad experience makes hospitals an undesirable place for children, creating frustration among parents of sick children.[3] Noncooperative children may affect the quality of treatment. A cross-sectional study conducted in Italy among a group of children who were chronically ill reported the median pain score for venipuncture as 8/10 using the Wong Baker Faces Pain Rating Scale, thus perceiving it as one of the most fearful procedures.[4] Though older children report severe pain and anxiety over a needle prick, it is usually the younger ones who have more fear and pain and hence, distraction is more beneficial for this age group.[5] According to research studies, the self-reported pain intensity during the procedure among children ranges from 3 to 5 on the Wong–Bakers pain scale. Pain causes children to develop needle phobia, especially with intravenous injections.[6]

Many studies detected that a large number of children do not receive techniques, which reduce or prevent pain during the procedures. If health-care providers fail to prevent needle pain, it can cause several psychological effects, such as anxiety and phobias, and increase perceptions of pain in the future.[7] Pain affects physiological, psychological, and emotional issues. The result of unmanaged pain during invasive procedures in children increases needle phobia, anxiety, and unpleasant feeling. It is defined like fear and anxiety that come out from a bad experience.[8] A randomized control trial reported that children with cognitive issues also perceive higher intensity of pain. Similarly, another trial reported that vaccine-related pain is also most feared among children. Sixty percent of children reported needle fear. In addition, it is estimated that needle phobia affects most of the population. This makes it important for nurses to implement different approaches to relieve pain.[9,10] Utilizing nonpharmacological methods to cope with invasive procedure pains like intramuscular or intravenous injections has always been a choice of not only nurses but also patients irrespective of adults or children.[11]

There are many different interventions, both pharmacological and nonpharmacological studies, to reduce acute procedural pain in pediatrics. The side effects of pharmacological interventions like lidocaine (EMLA 5%) cream and vapocoolant sprays make them not a preferable method to use with children.[12] There exist several nonpharmacological ways that have a beneficial effect in reducing this kind of pain. The use of music, virtual reality, hypnosis, deep breathing techniques, singing, reading a book, balloon inflation, video games, and kaleidoscopes as a behavioral distraction, stroking, and shot blocker as tactile interventions are examples of nonpharmacological interventions that have been used in pediatrics; in addition, sweet solutions are given for infants to reduce their pain.[13,14] Most of these interventions are considered time-consuming techniques as they require short training for health-care professionals and/or expensive, hence making it difficult to use them as routine care in hospital settings. However, alternatives that are easy to use, reusable, noninvasive, and inexpensive devices are needed. Many recent studies compiled as a systematic review showed the effectiveness of thermomechanical intervention via devices like Buzzy in reducing pain and anxiety in children during invasive procedures. Using external cold and vibration has proved to be easy to use, cost-effective, and impactful in pain and anxiety reduction.[15] There is no previous study that has tested the Buzzy device among Omani children. This study aims to introduce and evaluate the Buzzy Bee device (an animated bumblebee design using a cold gel pad and vibratory action) used for distracting the child and reducing the pain and anxiety during invasive pricks.

Materials and Methods

The main objective of the study was to evaluate the effectiveness of the Buzzy Bee device on pain perception among children undergoing invasive needle pricks as part of their treatment. The current study used quasiexperimental design. It started in February 2020 but was interrupted due to the unanticipated Covid lockdown. The data collected were completed by 2021, followed by analysis.

Study design and setting

Post-test-only control group design was used, in which the participant self-reported pain and the ratings were recorded after the intervention. It included the patients who were admitted to a Day Care at the Paediatric Outpatient Department and in Paediatric Wards in a Public University Hospital where the IV cannulation procedure and blood withdrawal using scalp vein set/butterfly needle was done.

Study participants and sampling

The study population was school age children who were included with an age range from 5 to 12 years old. Children who visited the hospital for treatment purposes and underwent IV cannulation or blood sample withdrawal for treatment and diagnostic procedures were enrolled in this study using the convenience sampling technique. The children of this age group were selected because of their ability to understand the need to report pain intensity and follow instructions, and most of the literature related to these studies examined samples between the age references.[11] Children's ability to describe pain increased with age and experience

and changes in development stage.[12] The participant parents were able to read English/Arabic and consented to allow participation of their children. However, we excluded children who received IM injections on the gluteal region and had neurological conditions or cognitive impairments, pain sensory defects (e.g., chronic insensitivity to pain), chronic conditions like sickle cell diseases already manifested with pain or any other referral pains, cold sensitivity, and those who were scared of bees as the device was shaped like a bee. Figure 1 represents the conceptual framework for the study.

The sample size estimation was done using the OpenEpi software and the power analysis using G*Power. Referring to previous studies, the mean pain level in children using the Buzzy was reported as 3.66 (SD=/-2.02) and that in the control group was 4.74 (SD +/- 2.07); hypothesizing the same way considering the alpha level of 5%, a confidence interval of 95%, and a power of 80%, it was necessary to compare 57 children in each group. Anticipating an attrition rate of 10%, some children might drop from the study. The sample size was raised to 60 in each group, making a total of 120 samples. Simple random sampling was used, and participants who met the inclusion criteria were allocated into the interventional (n-60) and control groups (n-60) randomly into alternative groups.

Intervention

The research assistant recruited was trained first in the lab regarding how to use the device and how to apply it on the participants [Figure 2]. She was also instructed about ensuring to place the gel pad in the refrigerator when not in use and to use a cold box with ice while transporting it in the setting. Further, the data collection was conducted in the approved settings. The participants in the interventional group had the Buzzy Bee tied 5 cm above the actual invasive site at least 3 to 5 minutes before the actual procedure began. A prospective randomized control trial was done among school age children in which the Buzzy device was used and applied in a similar manner 5 cm above the site planned for puncture to have a venous access.[11]

Data collection

We measured the pain severity experienced during the invasive needle pricks while using the Buzzy Bee device through a tool called FPS-R, Faces Pain Scale – Revised.[16] It is a standardized tool available in the public domain, easily accessible from the International Association for the Study of Pain (IASP) website. It is a self-reported scale measuring the intensity of pain specifically designed for children between 4 and 16 years. This can be easily administered and has scores 0 (No pain) to 10 (Severe pain) alongside the faces with emotions. The instructions to use were already available in the Arabic version from the IASP website. Hicks *et al.* (2001)[17] tested the revised version of Facial Pain Scale (FPS-R) in a sample of 76 children undergoing an ear–piece procedure for reliability and found that the validity is found to have strong positive correlation with Cronbach alpha $r = 0.93$. The study clearly reports a strong positive correlation ($r = 0.92$) with the Visual Analogue Scale, specifically among children aged between 5 and 12 years old. The tool has also been used and cited in more than 140 studies and reported as a good measurement for pain in children.

Data analysis and interpretation

Data entry and data cleaning were done by the research assistant. Data Analysis was performed using

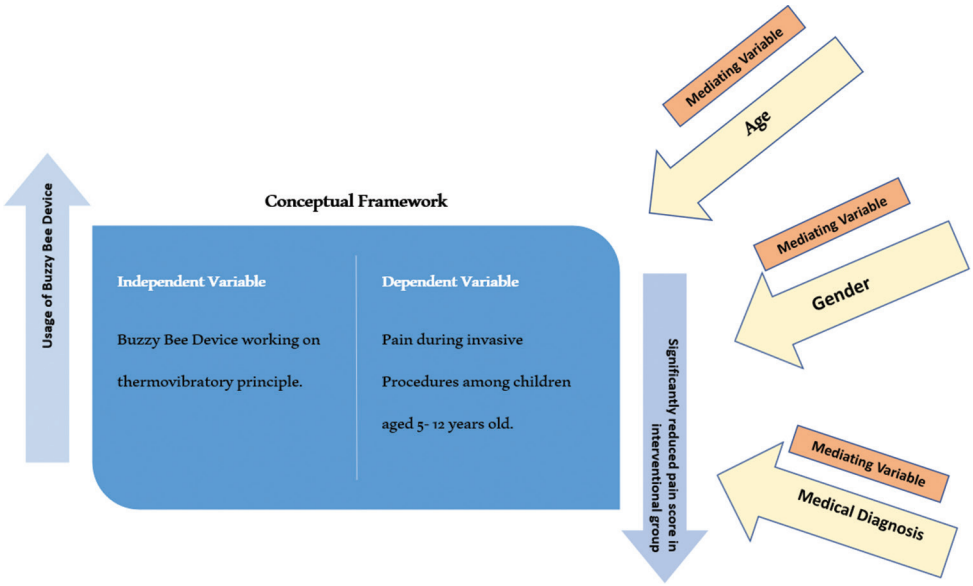

Figure 1: Conceptual framework

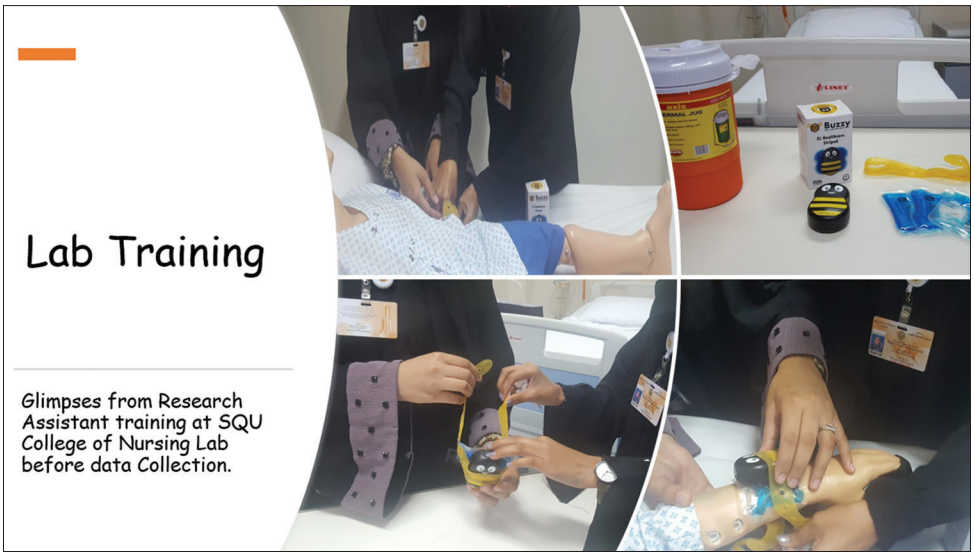

Figure 2: Research assistant training

Statistical Package for Social Sciences IBM (SPSS-IBM), version 22 (SPSS Inc., Chicago, Illinois, USA). The evaluation of the descriptive data was done using mean, standard deviation, frequency, and percentage distributions. Independent samples *t*-test was done to estimate the pain scores of the participants in the interventional and control groups. Pearson Chi square was used for evaluating the correlation between demographic data and pain experienced. Univariate analysis was done to explore the factors associated with pain reported by participants with or without the Buzzy Bee device. A generalized linear regression analysis was also done to understand the significant predictors of pain score among participants.

Ethical considerations

All participants were provided with parental Informed Consent and an Assent form for Children/Minors that uses a child friendly language about the intervention being done, purpose, and how to report the pain using Faces Pain Scale-Revised. Ethical approval from the Medical Research Ethics Committee (Ref.no SQU-EC/230/19, Approval Number #2023) was taken, and the permission to use the setting for data collection was obtained.

Results

Characteristics of the participating children

Among the 120 participants who consented, 63 (52.5%) of them were males and 57 (47.5%) were females. The mean age was 8.14 (+/-2.3) in both groups. All participants are school-going children. A majority of them were diagnosed with hematological conditions like thalassemia. Leukemia, and sickle cell disease and were getting cannulated for blood transfusion therapy [Table 1].

Table 1: Demographic information of participants with or without the BUZZY

Variable	BUZZY (*n*=60) *n* (%)	No BUZZY (*n*=60) *n* (%)	*P*
Age, mean±SD	8.15±2.14	8.13±2.21	0.967
Gender			
Male	26 (43.3)	37 (61.7)	0.067
Female	34 (56.7)	23 (38.3)	
Diagnosis			
Hematological	33 (54.2)	45 (77.6)	0.004*
Metabolic	12 (20.3)	12 (17.2)	
Other	15 (25.4)	3 (5.2)	

*Statistically significant, Test: Independent samples *t*-test, Chi-square test

Analysis of factors associated with pain

A univariate analysis was done to see if age, gender, and medical diagnosis had an influence on the pain perception among the children. The results tabulated were as follows: Children in the age group 5–8 had higher pain perception in both groups than the children in the age group 9–12. Based on gender, it was observed the pain perception was higher among the male children than the female children. It was also observed that children with metabolic diseases perceived higher pain levels in both groups than the other conditions [Table 2].

Comparison of pain between the interventional group and the control group

Findings show that 51.7% (31 participants) reported no pain in the experimental group and 33.3% (20 participants) reported only mild pain, whereas in the control group, only 5.0% (3 samples) reported no pain and 21.7% (13 samples) reported mild pain. About 26.7% samples reported very much pain as against the 1.7% who reported very much pain in the interventional group [Table 3]. The results are graphically represented [Figure 3]. There was a statistically significant difference

in the pain score between the control group and the experimental group (likelihood ratio test, $P = 0.0001$). The Buzzy Bee method significantly reduced the pain among children while undergoing the invasive procedure.

Common predictors of the pain score

A generalized linear regression analysis found that the Buzzy Bee device and the age of the child were the significant predictors of the pain scores of children [Table 4]. Children who undergo an IV insertion procedure using the Buzzy Bee device will experience 83.6% less pain than children not using the Buzzy Bee device.

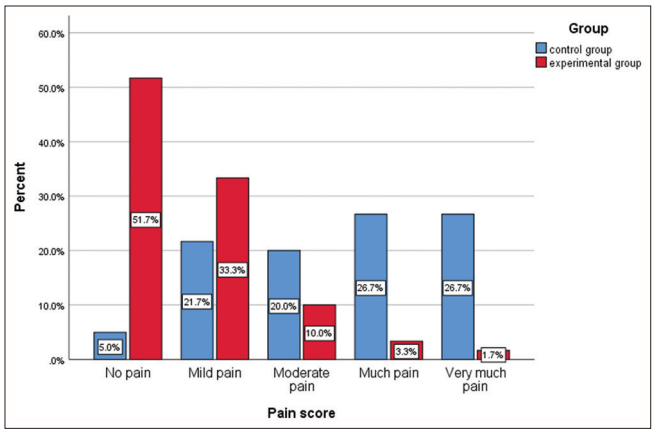

Figure 3: Comparison of pain score

Table 2: Univariate analysis of the factors associated with pain reporting by the child with or without the BUZZY

Variable	Mean±SD		*P*
	BUZZY (*n*=60)	No BUZZY (*n*=60)	
Age			
5-8 years	1.79±0.96	3.74±1.25	<0.001*
9-12 years	1.59±0.84	3.12±1.17	<0.001*
Gender			
Male	1.81±1.02	3.52±1.38	<0.001*
Female	1.62±0.82	3.46±1.17	<0.001*
Diagnosis			
Hematological	1.66±1.07	3.29±1.22	<0.001*
Metabolic	1.92±0.67	3.90±1.37	<0.001*
Other	1.60±0.74	4.67±0.58	<0.001*

*Statistically significant, Test: Independent samples *t*-test

Discussion

Children often fear needle pricks, and thus, invasive procedures are one of the most feared medical events. Their perception and experience of pain eventually alter their perception toward pain, thus increasing their sensitivity to pain.[18]

A systematic and meta-analysis paper examined the effectiveness of the Buzzy Bee device on procedural pain specifically in children. The chosen 9 studies had Buzzy Bee device as intervention, while no specific comparator in the control group was seen. The review reported that the usage of Buzzy Bee device as a distractive technique for needle-related pain was effective in helping children cope with pain and fear.[15] A single study assessed the effectiveness of the Buzzy Bee device in children who received immunization and reported that the children in the experimental group reported far less pain than those children in the control group.[19]

Our findings of this study also report that applying the Buzzy Bee device is a feasible intervention to alleviate the pain related to needle prick procedures, especially among preschool and school age children. Findings from a similar single-site study conducted in Taiwan reported that children using the Buzzy Bee device reported significantly lesser pain than those in the control group.[20] The mean age of children participated in the study was 5.04 years and preschoolers. Supported by another randomized control trial that evaluated the pain perception among children aged between 3 and 6 years of age reported that the pain perception among children undergoing phlebotomy was significantly lesser in the group that used Buzzy Bee as a device.[21]

Table 3: Group* Pain score Cross tabulation

	Pain score					Total
	Mild pain	Mild pain	Moderate pain	Much pain	Very much pain	
Group						
Control group						
Count	3	13	12	16	16	60
% within group	5.0%	21.7%	20.0%	26.7%	26.7%	100.0%
Experimental group						
Count	31	20	6	2	1	60
% within group	51.7%	33.3%	10.0%	3.3%	1.7%	100.0%
Total						
Count	34	33	18	18	17	120
% within group	28.3%	27.5%	15.0%	15.0%	14.2%	100.0%

Table 4: Generalized linear regression analysis of the factors that are best predictors of the pain score of the child

Parameter	β	Std. Error	*P*	Exp (β)	95% CI for Exp (β)	
					Lower	Upper
Constant	3.564					
Age						
9-12 years	-0.411	0.1942	0.034*	0.663	0.453	0.970
5-8 years (Reference)				1		
Gender						
Female	-0.046	0.2019	0.821	0.955	0.643	1.419
Male (Reference)				1		
Diagnosis						
Other	0.241	0.2357	0.306	1.273	0.802	2.020
Metabolic	0.450	0.2494	0.071	1.568	0.962	2.557
Hematological (Reference)				1		
Group						
BUZZY	-1.807	0.2191	<0.001*	0.164	0.107	0.252
No BUZZY (Reference)				1		

*Statistically significant

However, it was observed that age of the participants influenced their pain perception. It was observed from our study that children of 5–8 years of age had higher pain perception than children of 9–12 years of age. A qualitative study done among nurses done regarding management of pediatric pain reported that nurses believed that the physiological and behavioral changes in infants and younger children could be a cause for increased pain perception.[22]

Similarly, our study also observed that pain was perceived higher in males than in females and those diagnosed with metabolic conditions perceived more pain comparatively in both groups. However, regarding gender, medical diagnosis, and the correlation between intensity and unpleasantness ratings of pain, the literature does not permit definitive predictions. We assume it could have been an incidental finding but cannot be generalized as the sample size was not large enough.

The consent and willingness to participate in the study by the parents and the children suggest that a distractive pain-relieving equipment like the Buzzy Bee device has a welcoming acceptability to ensure better pain management during needle-related procedural pain. We suggest that devices like Buzzy Bee with a vibratory thermoregulatory mechanism should be a part of the nursing pain care kit in the injection and venipuncture rooms for an efficient management of pain and thus gaining the cooperation of the sick children for the procedure. Furthermore, the device is used for the intervention is available in different sizes and is gender- neutral equipment, making it a beneficial distractive method. Additionally, a bravery badge from the same product company was used as a positive reinforcement for the children who underwent a needle prick.

Needle prick-related procedures, namely, intravenous cannulation, are considered as one of the most painful procedures among children. Managing pain is considered complex in children as their pain perception varies from child to child. Choosing age-specific pain relief methods which are nonpharmacological in nature comes handy for the health-care professionals, especially nurses to cope with the fear and anxiety of children undergoing the needle prick.[23] Results of our study indicated that the pain score was significantly decreased among the children in the interventional group where the Buzzy Bee device was used. The lowered postinvasive procedural pain was appreciated mainly due to the presence of a control group who did not receive any specific pain distractive measures. A randomized control trial supported the findings of our study; it evaluated the effectiveness of the Buzzy Bee device on children aged between 1 month and 18 years who had to undergo blood sampling in a pediatrics unit at the Pisa University Hospital. Around 240 participants were allocated into the experimental and control groups. The interventional group reported a lower pain score compared to the noninterventional group. Though the age range was wide from 1 month to 18 years, there was no significant correlation for pain; the study reported pain is inversely corelated to age. There were no significant pain score differences noted between boys and girls.[24] Another randomized control study was conducted among children aged 3–6 years attending the pediatric phlebotomy unit. In this study, the researchers compared two nonpharmacological methods, the Buzzy Bee device for group 1 and the puppet for group 2, and compared their effects with the control group, which is group 3. A total of 105 students were divided among the three groups. A statistically significant difference was reported by the study; children in the experiment group reported significant pain relief, while those in

the puppet group reported less stress and fear during the procedure.[21] Findings from a similar study having the population age group the same as our population of children between 5 years to 12 years were found in a pediatric emergency department in Turkey. The study recruited 161 divided between three groups, including Buzzy Bee group, cold spray group, and control group, which received standard care. The study reported that usage of both the Buzzy Bee device and a cold spray were equally effective in reducing pain, while the anxiety and fear levels were significantly lesser in the Buzzy Bee group,[25] thus confirming that Buzzy Bee is child-friendly device to cope with pain and anxiety.

Limitations and recommendations

The intervention was easy to implement and proved effective among the children aged between 5 and 12 years of age specifically in addressing invasive pain during intravenous cannulation and blood specimen collection; however, the sample size is small and might affect generalizability considering coping with pain is subjective. The study findings also recommend having more research studies in the similar age groups using the Buzzy Bee device to add to the scientific literature.

Conclusion

The Buzzy Bee device uses the thermovibratory principle has been effective in distracting children and relieving the pain experienced by them during their intravenous cannulation procedure. It is cost-effective equipment which can come handy to nurses working in pediatric units to help cope fear and pain toward injections.

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Conflicts of interest

There are no conflicts of interest.

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