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The Effect of Virtual Reality-Based Intervention Technique on Reducing Pain in Children with Burns During Dressing Changes

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Introduction

Children's burns are an important global health problem, with an increase in the proportion of non-lethal injuries in children. Burn injury is a common form of childhood injury, often caused by shocks and contact heat, as well as friction, electrical energy and chemical sources (Nassar et al., 2023).

Burn injuries are classified based on a variety of variables, including depth, origin, and percentage of body surface area injured. The degree of burn injuries is determined by a combination of the classifications listed above (ŻwiereHo et al., 2023). There are four main types of burns: first, second, third, and fourth degrees. Each degree is based on severity (Bereda, 2022). superficial burn causes localized skin irritation. Sunburns are often classified as first-degree burns. Pain, redness, and

ABSTRACT

Objective: To evaluate the effectiveness of a virtual reality-based intervention (VRBI) in reducing pain during dressing changes among children with burn injuries.

Methods and Materials: A quasi-experimental design was employed at three burn centers in Baghdad and Al-Zahraa Teaching Hospital, Wasit Governorate. The study included 110 pediatric burn patients aged 6–17 years, equally divided into experimental and control groups (55 each) selected through purposive sampling. The intervention group used Meta Quest 2 virtual reality headsets during dressing changes, while the control group received standard care. Pain intensity was measured using the Wong–Baker Facial Pain Scale immediately after each procedure. Data were analyzed using SPSS version 26 with descriptive statistics and chi-square tests.

Findings: Results showed a substantial reduction in pain among children exposed to the VR intervention. In the experimental group, 45.5% reported “no pain,” and 34.5% “hurt a little bit,” while in the control group, 65.5% reported “hurts a whole lot” and 34.5% “hurts worst.” The difference between groups was statistically significant ($p < 0.05$). No significant associations were found between pain scores and demographic variables except for residence ($p = 0.004$).

Conclusion: Virtual reality immersion significantly decreases procedural pain in children undergoing burn dressing changes. VRBI offers a safe, engaging, and cost-effective non-pharmacological strategy for pediatric pain management. Broader implementation and multicenter trials are recommended to validate its long-term benefits.

Keywords: Virtual Reality, Pediatric burns, Pain management, Dressing change.

moderate swelling are signs of inflammation ([Mukaddes & Junaid](#)).

Burns can lead to blisters on the skin, along with pain, redness, and inflammation in second degree. The second-degree burn is categorized into two types: Superficial partial thickness and deep partial thickness. Superficial partial thickness burns damage only a portion of the dermis and may not result in scarring. In contrast, deep partial thickness burns are more severe and can cause scarring and permanent change in skin color. Typically, superficial partial heals in less than three weeks, while deep partial thickness burns also usually heal within that time frame ([He et al., 2021](#)).

The first and second layers of skin are damaged, as well as the underlying tissue, in a third-degree burn. The burn site is usually black or burned, exposed to white fat tissue. The deep burn may cause damage to the muscles or bones of the skin. The end of the nerve is generally destroyed, so there is little or no pain at the location where the total thickness burns ([Shpichka et al., 2019](#)). Burns can lead to destruction of all layers of the skin, as well as the bones, muscles, and tendons in fourth-degree burns. These injuries are life-threatening because they extend through the skin into the underlying soft tissue. They are the deepest and most severe type of burns ([Tamparo, 2016](#)).

Methods and Materials

This study uses a quasi-experimental design. The study sample was collected from pediatric burn patients treated at the Specialized Burn Center and Al-Kindy Hospital in Baghdad and the Burn Center at Al-Zahraa Teaching Hospital in Waist Governorate. The total number of burn cases in the age group (6-17) included in the study for the year 2024 was approximately 305 cases. 110 patients were included in the data analysis divided into two group, namely the control group (55 patients) and the study group (55 patients) for each center, as shown in Table 1, two patients were excluded from the sample due to non-compliance to reporting the pain level they experienced. To ensure a transparent and

scientific recruitment process, the research used non-probability purposive sampling in this study is selected according to the following criteria. The minimum sample size for this study was set at 110 patients based on the calculation of the minimum sample size by Rao soft equation using a confidence level of 80% and a margin of error of 5%.

Inclusion criteria were Children will be included in this study based on certain criteria. They must be between 6 and 17 years old and have suffered burns. In addition, they must be able to collaborate and perform self-assessments to ensure the accuracy of the results. It is also important that they have no history of psychiatric disorders or mental illness, as these could affect their response to the study. In addition, they must require daily dressing changes as part of their health care routine and have the ability to communicate verbally, which will facilitate interaction throughout the research process.

Intervention procedures

After obtaining informed consent from the caregivers of the children participating in the study, participants were divided into two groups: the intervention group and the control group. The intervention group received a virtual reality-based intervention in which participants wears Meta Quest 2 virtual reality headsets from Meta Quest company during dressing change sessions. This intervention allowed children to be immersed in an interactive and engaging virtual environment (e.g., a roller coaster scene), which helped distract their attention from the pain and anxiety associated with changing burn dressings. The virtual reality experience was implemented only once during a dressing change. Sessions were closely monitored to ensure children's comfort and safety throughout the intervention. The control group received no intervention during dressing changes and followed the same procedures but without the use of virtual reality. Pain levels were measured using the Wong-Baker Facial Pain Scale. Participants were asked to indicate their level of pain based on the faces are present in the scale.

Table 1

Distribution of study sample at setting of study

Setting of study	Experimental group	Control group
Specialized Burn Center	38	34

AL-Kindi Teaching Hospitals	10	11
AL-Zahraa Teaching Hospitals	7	10

Instruments

The questionnaire is one of the means of collecting data that contributes to achieving the results expected of the study, and researchers have developed this questionnaire to clarify the objectives and importance of the study by asking questions. The questionnaire includes two parts, including: Part I: Social Demographic and clinical Data, Part II: Wong-Backer Face Rating Scale.

Part1: Children's sociodemographic Data

This section consists of (eight) items relating to the collection of data from patients, including sex, age, residence, monthly income, hospital stay, source of fire, type of house hold measures used before hospital admission, extent of fire and duration of dressing change

Part 2: Wong –Backer Face Rating Scale

The scale has been shown to be effective and reliable in assessing children over 3 years of age. It is considered the most widely used scale in children and was approved by the author of the scale for use in this study. The scale combines numbers and pictures to assess pain. The scale consists of six different facial expressions that indicate different levels of pain, from "no injury" to "most severe injury." Each face has a numerical value from 0 to 10. Children can easily understand the faces and emotions on the scale and highlight those that are most closely related to their pain. An excerpt to explain the pain rating for each face:

"No pain" is expressed on the first face with a pain rating of (0). The second face has a pain rating of 2. "It hurts a little." "It hurts a little more" reads the third face with a pain rating of 4 points. The fourth face says, "It hurts even more" and has a pain rating of (6). The fifth face has a pain value of (8) and expresses: "It hurts a lot." The sixth and final face expresses the most severe pain, and the pain value (10) indicates the most severe pain. The use of the Wong-Baker Pain Scale was approved by Connie Baker, the owner of the foundation.

Language and content Validity of the study instrument

The tool was translated by a bilingual specialist from Kirkuk University and translated from English to Arabic using the forward backward translation method. The tool was then translated into English and when compared with the original version, identical results were found. The validity of the tool refers to the extent

to which it measures what it is intended to measure. To ensure the usefulness of the tool, it must contain all the analytical elements, and its wording and terminology must be clear enough that they can be understood by anyone who uses it. The validity of the research tool has been verified by experts. The expert team consists of 15 experts to assess the content validity. All experts have more than eight years of experience. The content validity was assessed by six experts from University of Baghdad/ College of Nursing, one from Kufa university/ College of Nursing, two from Mosul university/ College of Nursing, one from College of Nursing/ Babylon University, three physicians from Al-Karama Teaching Hospital in Waist Government, and two from doctors at the University of waist. To make the questionnaire more effective, experts were asked to comment on the appropriateness of the wording of each questionnaire and the relevance of the study context, and to make suggestions on each questionnaire. Expert opinions suggested that minor changes were needed in some elements of demographics. These changes were implemented based on their suggestions and the final version was prepared for research purposes.

Reliability of study instruments (Pilot study)

The researcher confirmed the face validity of the study instrument and applied it to the random sample of 10 children selected in the pilot study using one test method who were excluded from the original study. The researcher conducted a pilot study from 22 November 2024 to 27 November 2024 to evaluate the validity, accuracy, relevance and validity of the questionnaire. Ten children, five boys and five girls participated in the pilot study using purposive sampling technique. Participants were divided into two groups: the intervention group and the control group. The intervention group received a VR-based intervention aimed at reducing pain, reducing anxiety, and improving dressing changes in children with burns. Participants wears meta quest VR headsets during dressing change. while the control group received no intervention. The researcher applied one test method to examined the sample by used of Cronbach's Alpha measurement, the results was (0.824) at using SPSS version 26.

Data Collection

The researcher initiated one-on-one interviews with the parents and asked for their explicit consent to participate in the study. During these interviews, the researcher clearly explained the objectives of the study. After obtaining verbal consent from the parents, the researcher assured them that all disclosed information would be kept confidential. The data collection process began after obtaining consent. It took place as planned from 28/11/2024 to 30/12/2025. A unified two-part questionnaire in Arabic was used to collect data. The first segment included demographic and clinical data, the second component included pain assessment using Wong-Baker faces. The first part of the questionnaire was completed based on information obtained from the patient. The second part was based on the child's responses to pain, represented by the faces on the Wong-Baker scale. The time it took each participant to complete the questionnaire ranged from 30 to 40 minutes.

Ethical Consideration

Before starting data collection, the study received official approval from the relevant authorities, including the Faculty of Nursing at University of Baghdad. The Ethics Committee then reviewed the research protocol, questionnaire and expert panel before approving the title of the study. The researcher submitted a detailed explanation of the project, including objectives and methods, to the ministry of planning/authority of

statistics & geographic information systems. To ensure the integrity of the study and the professionalism of its processes, strict ethical considerations were followed. The researcher obtained informed consent from all participating parents and children without revealing the names of the children and explained the purpose of the study in detail. Participants were reminded that they were free to decide whether to participate or not, with an emphasis on preserving their autonomy.

Registration of a clinical trial is the process of publishing detailed information about the research design and expected results of the study in a public database that is free to use for all and managed by a non-profit organization. Registration of such clinical trials is necessary to identify similar studies, which in turn avoids duplication of studies and is necessary to avoid publication bias. approval for study registration was obtained from the Iranian Registry Clinical Trials ID20241114063706N9

Analysis

In the present study, the data are analyzed through the use of Statistical Package for Social Science (SPSS) version 26. Frequencies and percentages are used to calculate the description of demographic characteristics. Means and standard deviation are used to estimate the value of the data. Pearson coefficient correlation (r-test) was applied for the reliability testing of the instrument.

Findings and Results

Table 2

Statistical Results of the Demographic Variables for the Sample (Experimental and Control Groups) in the Study

Demographic	Estimate	Experimental Group		Control Group	
		Freq	%	Freq	%
Sex	Male	27	49.1	22	40.0
	Female	28	50.9	33	60.0
Age	6- Less than 8 years	24	43.6	11	20.0
	8- Less than 10 years	2	3.6	2	3.6
	10- Less than 12 years	4	7.3	8	14.5
	12- Less than 14 years	3	5.5	15	27.3
	14- Less than 16 years	4	7.3	4	7.3
	16- Less than 18 years	18	32.7	15	27.3
Address	Rural	3	5.5	2	3.6
	Urban	52	94.5	53	96.4
The Monthly Family Income	Less 300,000 ID	18	32.7	23	41.8
	300,000 ID - 600,000 ID	5	9.1	14	25.5
	601,000 ID - 900,000 ID	12	21.8	6	10.9
	More than 900,000 ID	20	36.4	12	21.8
Total		55	100.0	55	100.0

F=Frequency, %= Percentage

The Table 2 presents the statistical results of the demographic variables for the sample (experimental and control groups) in the study, that 50.9% (28) of the sample at experimental group and also 60.0 (33) of the sample at control group were female sex. 43.6% (24) of the sample age at experimental group between 6 – less than 8 years old but 27.3% (15) of the sample age at control group between 12 – less than 14 years old. 94.5%

(52) of the samples at experimental group and also 96.4% (53) of the sample age at control group were addressed in urban area. 36.4% (20) of the sample monthly income at experimental group was more than 900,000 ID but 25.5% (14) of the sample monthly income at control group between 300,000 ID - 600,000 ID.

Table 3

Statistical Health History Results of Burn for the Sample (Experimental and Control Groups) in the Study

Estimate		Experimental Group		Control Group	
		Freq	%	Freq	%
Burn Degrees	First Degree	19	34.5	6	10.9
	Second Degree	31	56.4	29	52.7
	Third Degree	5	9.1	20	36.4
The surface area exposed to burning	Head	0	0.0	1	1.8
	Right hand	7	12.7	1	1.8
	Left hand	4	7.2	3	5.6
	Chest	1	1.8	0	0.0
	Back	3	5.6	3	5.6
	Abdomen	3	5.6	1	1.8
	Right foot	4	7.2	2	3.5
	Left foot	4	7.2	1	1.8
	Two different regions	20	36.4	20	36.4
	Three different regions	4	7.2	5	9.0
	Four different regions	3	5.6	7	12.7
	All body regions	2	3.5	11	20.0
Total		55	100.0	55	100.0

F=Frequency, %= Percentage

The Table 3 presents the statistical health history results of burn for the sample (experimental and control groups) in the study, that 56.4% (31) of the sample burn degrees at experimental group and also 52.7% (29) of

the sample burn degrees at control group were second burn degree. 36.4% (20) of the sample surface area exposed to burning at experimental group and also at control group were two different regions.

Table 4

Statistical Results of Wong –Backer Face Rating Scale for Children with Burn between the Sample (Experimental and Control Groups)

		Experimental Group		Control Group	
		Freq	%	Freq	%
1.	No hurt	25	45.5	0	0.0
2.	Hurts a little bit	19	34.5	0	0.0
3.	Hurts a little more	6	10.9	0	0.0
4.	Hurts even more	5	9.1	0	0.0
5.	Hurts a whole lot	0	0.0	36	65.5
6.	Hurts worst	0	0.0	19	34.5
Total		55	100.0	55	100.0

F=Frequency, %= Percentage

Table 4 shows the statistical results of Wong –Backer Face rating scale for children with burn between the sample (experimental and control groups), that 45.5% (25) of the sample at experimental group was no hurt

level according to Wong –Backer Face rating scale, but 65.5% (36) of the sample at control group was hurts a whole lot level according to Wong –Backer Face rating scale.

Table 5

The Statistical Relationship between the Demographic Variables with Dressing Change Period, Wong –Backer Face Rating Scale and Anxiety Rating Scale for Experimental Group

	Wong –Backer Face Rating Scale	
	P.value	Sign
Sex	0.693	NS
Age	0.438	NS
Address	0.004	S
Monthly Family Income	0.138	NS

Sign=Significant at P.value ≤ 0.05 level, S=Significant, HS= High Significant, NS=non-significant.

Table 5 shows the statistical association between the demographic variables with Wong –Backer face rating scale for experimental group. There was non-significant association between all demographic variables with

Wong –Backer face rating scale results at p.value ≤ 0.05 level except with address was significant association at p.value (0.004) only.

Discussion and Conclusion

The results presents the demographic characteristics of the study sample, including the experimental and control groups. It can be seen that in both groups, more than half of the participants were female. This result is consistent with a study by consistent with a study by Naif & Hassan, (2024), who reported that female accounted for 97% (32) of sample. This result consistent a study by Mohammed & Mohammed, (2024) who found that female accounted for 82.4% (84) of the sample. This result agrees with a study (Mohamed Ahmed Madkour et al., 2024; Nasser & Hassoun, 2020) who found that male accounted for 57.1% (36) of sample. This result disagrees with a study Shawq AH(Shawq, 2024)⁽¹¹⁾ who found that male accounted 58.3% (35) of sample . From the researchers' point of view, several factors are responsible for the higher rate of burns in female. A major factor is that female are more likely to perform household activities such as cooking or handling hot liquids, as well as using hot utensils such as kettles or pots, which increases their risk of burns.

Regarding the age distribution, most of the participants in the experimental group were between 6 and 8 years old, while most of the participants in the control group were between 12 and 14 years old. This

result is consistent with the study by Naser & Al-Fayyadh, (2024) who found that 45.3% (34) of children were between 6 and 8 years old. This result consistent with study by Mizal & Mohammed, (2024) found that 41.6 % (52) of participant between 5 and 8 years of age. This result is inconsistent with the study by Khadyer & Hassan, (2019) who found that 63.3% (19) of children were between 1and 3 years old. According to researcher point of view, burns are more common in the age group of 6 to 8 years because children in this age group are less aware of the dangers posed by hot liquids and objects. This inattention often leads to unintentional accidents while playing or running around the house.

Regarding residence, most of the participants in both groups lived in urban areas. These results are consistent with those of a study by AL-Shammary & Sadeq, (2024) who found that 75.7% of participants in the control group, 63.5% of the placebo group shot blocker, and 63.3% of the shot blocker group lived in urban areas. This result is consistent with a study Mohammed & Hatab, (2022) who found 85.7% of participant lived in urban area. This result is consistent with a study Abbood & Naji, (2023) who found 56.1% of participant lived in urban area, according to the researcher point of view. Several factors contribute to this, including the widespread use of household appliances and electronic

devices, which increases the risk of electrical and burn injuries in children in urban areas. In addition, the pressure of city life can lead to neglect and inadequate supervision of children, which further increases the risk of burns.

Regarding household income, the majority of the individuals studied in control group had income range between 300,000 and 600,000 Iraqi dinars. On the other hand, the participants in the experimental group had a monthly income of more than 900,000 Iraqi dinars. This result is consistent with a study by [Abd Ali & Musihb, \(2024\)](#) who reported that 28% of the families earned between 300,000 and 600,000 dinars, while 29% earned more than 900,000 dinars. On the other hand. This result is not consistent with study by Mohammed AQ [Mohammed, \(2023\)](#) found that about 38.1% of the families earned less than 300,000 dinars.

The results showed that the majority of participant in study had second degree burn. This result is in line with a study conducted by [Shoghi et al., \(2022\)](#) who found that 92.5% of the children suffer from second degree. This result is in line with a study conducted by [Khadra et al., \(2018\)](#) who found that 53.3% of the children suffer from second degree. This result is in line with a study conducted by [Sharshor et al., \(2023\)](#) who found that 100.00% of the children suffer from second degree of burn. Researcher point of view: The high number of second-degree burns can be explained by a combination of factors, including the type of agent used to cause the burns, such as hot liquids such as boiling water. In addition, children's skin is thinner and more sensitive than that of adults, making them more susceptible to burns. In addition, children's body surface area to body weight ratio is greater than that of adults, which increases the impact of burns on their bodies. In addition, lack of knowledge about preventive measures and safety practices is a major contributor to the increased risk of second-degree burns in children. These combined factors make children more vulnerable to this type of burn.

Regarding body surface area exposed to burns, the majority of children in the experimental group and the control group suffered burns on two different body regions. This result is disagreed with a study by [ABDELTWAB et al., \(2023\)](#) who found that 48.33% of children had burns on different body regions. From the researcher point of view, flammable clothing contributes

significantly to increasing the risk of burns on the body surface and presence of flammable materials near the source of the fire can lead to rapid spread of the fire and further increase the affected body surface area.

Table (3): Statistical Results of Wong –Backer Face Rating Scale for Children with Burn between the Sample (Experimental and Control Groups)

The table shows the statistical results of Wong-Backer Rating Scale for children with burns in the sample presented: the majority of the children in the experimental group reported no pain at all. in contrast, the majority of children in the control group felt severe pain. This notable difference reflects a significant disparity in pain perception between the two groups and highlights the effectiveness of using virtual reality as a means of pain relief in children with burns in the experimental group. This result consistent with study with a study Abd EL Ghany Y, Samir EA, Mahmoud RA [Ghany-Abd EL-Fatah et al., \(2024\)](#) who found 66.7% of children in experimental group reported no pain and 56.6% of children in control group reported hurts worst. This result is consistent with a study by [Kaya & Özlü, \(2023\)](#) who found that 0.89% of the children in the experimental group reported no pain and 0.93% in the control group experienced severe pain. This result is consistent with a study by [Fatma & Ghada, \(2019\)](#) who found that 63.4% of the experimental group reported no pain and 46.7% of the group experienced severe pain. On other hand this result disagrees with a study [Sharshor et al., \(2023\)](#) who found 92.00% of children with second degree burn in experimental group had moderate pain and 100.00% of children in control had severe pain. From the researcher point of view, virtual reality is an effective way to relieve pain in burn patient because it distracts their attention from pain during wound care. By stimulating the senses with positive experiences, virtual reality helps reduce attention to pain and thereby reduces the activation of areas of the brain such as the thalamus and limbic system. This leads to decrease in the patient's awareness of pain and effectively alleviates their pain sensation.

The results showed a significant relationship between demographic variables such as age, gender, address and monthly household income and pain. The results indicate a statistically significant association between participants' address and their pain scores. However, no significant associations were found between age, gender

or monthly household income and pain scores. This result is consistent with the study of [Naser & Al-Fayyadh, \(2024\)](#) who found no statistically significant difference between pain intensity and demographic variables except for age group. Regarding age, the current study did not find a statistically significant association between age and pain scores. However, a previous study reported a significant inverse association between age and pain intensity in children. Regarding gender, the current study found no statistically significant differences in pain scores between males and females. This is consistent with a previous study that also found no significant differences in pain intensity between genders. Regarding address, the present study found statistically significant differences in pain scores between the different address groups. This is consistent with a previous study that also reported significant differences between the residential groups. The result is consistent with another study by [Thbeet & Shoa, \(2022\)](#) who found a non-significant association between demographic characteristics and pain. From researcher point of view, a significant association was found with respect to age. A place of residence is influenced by pain perception due to factors such as quality of healthcare and living conditions. People living in rural areas experience greater pain than those living in cities because of limited access to health services. This difference reflects the influence of social and environmental factors on pain perception.

Based on the discussed results, the present study successfully supports the research hypothesis that immersive intervention techniques based on virtual reality have a significant positive effect on pain relief in children with burns during dressing changes. Statistically significant differences in pain levels, measured with the Wong-Baker scale, were observed between the experimental and control groups, with favorable results for the experimental group. These results underline the importance of virtual reality as an innovative and effective tool for pain management in children with burns. By reducing pain during dressing changes, this technology positively contributes to children's physical well-being and alleviates their suffering. It represents a significant advance in improving the quality of care and recovery outcomes in children with burn injuries.

It is recommended that hospitals and specialized pain management centers introduce innovative technologies

such as virtual reality in the treatment of burns. Regular training programs should be implemented for all nurses in burn units to ensure that they are effectively trained in the use of virtual reality technologies in healthcare. To ensure a complete and accurate understanding of intervention effects and thus obtain more generalizable results, further studies with larger sample sizes from different geographical areas are needed. More research is needed to assess the psychological and social benefits of virtual reality technologies and to examine their long-term impact on the overall recovery of children with burns.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

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

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Authors' Contributions

All authors equally contribute to this study.

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