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Effectiveness of augmented reality intervention on pain and comfort during wound dressing among children undergone abdominal surgery

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Abstract
Children undergoing abdominal surgery frequently experience significant pain and discomfort during postoperative wound dressing, posing physical and psychological challenges. This study aimed to evaluate the effectiveness of augmented reality (AR) as a non-pharmacological intervention for pain and comfort management during wound dressing among children aged 5-12 years at a selected hospital in Coimbatore. The conceptual framework used in the study was Roy's Adaptation Model (1996), which focuses on helping individuals adapt to changes in physiological needs, self-concept, and role functions. A quantitative evaluation approach with a quasi-experimental post-test-only control group design was adopted. A non-probability purposive sampling technique was used to include 50 children, 25 in the experimental group to receive the AR intervention, and 25 in the control group. The data collection tool and technique involved an interview schedule for demographic data, bio-physiological parameters measured by a pediatric cardiac monitor, the Children's and Infants' Postoperative Pain Scale (CHIPPS) for pain assessment, and a modified comfort scale for comfort assessment. The AR intervention, involved a 10-minute Pokémon game during wound dressing on the 1st and 2nd postoperative days, and the effectiveness was evaluated by observing children's pain reactions, comfort levels, and bio-physiological parameters. Tools' validity was ensured through expert feedback and reliability by the inter-rater method. A pilot study was done to confirm the feasibility, prior to the main study. Ethical considerations included obtaining ethical clearance from the Institutional Ethical Committee, formal written permission from hospital authorities, informed consent from the children and their parents and privacy and confidentiality were maintained throughout the study. The major findings of the study showed that there was a significant difference in mean pain and comfort score in experimental and control group. In experimental group, the mean pain score was 5.24 and in control group the mean pain score was 12.20 ($t=27.634$, $df=48$, $p<0.05$). In experimental group, the mean comfort score was 5.22 and in control group mean comfort score was 13.56 ($t=26.008$, $df=48$, $p<0.05$) during wound dressing. The study concluded that the augmented reality intervention was effective in reducing pain and increase comfort during wound dressing.

Keywords: Augmented reality intervention, pain, comfort, children having abdominal surgery, wound dressing

Introduction
Children aged 5-12 years commonly undergo abdominal surgeries, which include a variety of procedures designed for both acute and chronic conditions affecting the abdominal region. Common types of abdominal surgeries include appendectomy, herniotomy, and laparoscopic procedures.

Children undergoing abdominal surgery commonly face health issues that can impact their recovery and overall well-being. These issues include physical and psychological problems that can be categorized into those experienced during the postoperative period and those specifically related to wound dressing.

During the postoperative period, physical issues include pain at the surgical site, accompanied by swelling and bruising, gastrointestinal problems such as nausea, vomiting, and constipation due to anesthesia and changes in diet, and psychological issues experienced after surgery such as increased anxiety and fear.

A randomized controlled trial conducted by Mott *et al.* (2008) [6] evaluated the efficacy of an augmented reality system in alleviating pain during burn dressing changes in children. The study found that mean pain scores were significantly lower ($p = 0.0060$) in the AR group

compared to the control group, with notable changes in respiratory and pulse rates over time within groups. This trial highlights the potential of augmented reality as a valuable adjunct to pharmacological analgesia in pain management.

Chandana K *et al*. (2023) [9] conducted a study on pediatric surgical conditions in a rural tertiary care hospital in Andhra Pradesh, finding that out of 453 children admitted to the pediatric ICU, 183 were surgical cases. The most common conditions included inguinal hernia (6%), appendicitis with perforation (5.4%), cholelithiasis (1.6%), and small bowel obstruction (1%).

Abdominal surgeries, including procedures such as appendectomy, herniotomy, and laparotomy, often involve invasive techniques that result in substantial postoperative pain. The process of wound dressing is essential for healing, which can exacerbate the discomfort.

Pain management in pediatrics requires a combination of pharmacological and non-pharmacological approaches. Non-pharmacological methods, such as relaxation, distraction, and immersive technology, offer alternative solutions to reduce pain and improve comfort. One of the non-pharmacological approach is Augmented reality.

Distraction techniques are often employed by pediatric nurses to alleviate pain during wound dressing, benefiting both the children and their caregivers. Distraction techniques involving immersive technologies, such as virtual reality (VR) and augmented reality (AR), are emerging as effective non-pharmacological interventions for managing postoperative pain and anxiety. AR, in particular, enhances the physical environment with virtual elements and can be used on mobile devices like smartphones and tablets. Unlike VR, which creates a completely virtual environment, AR overlays digital images onto the real world, providing an interactive and engaging experience.

AR can provide immersive and interactive experiences that potentially distract patients from pain and discomfort, thereby improving their overall experience during medical procedures.

Statement of the problem

A study to assess the effectiveness of augmented reality intervention on pain and comfort during wound dressing among children undergone abdominal surgery in a selected hospital at Coimbatore.

Objectives

- To assess the level of pain among the experimental group and control group during wound dressing.
- To assess the level of comfort among the experimental group and control group during wound dressing.
- To assess and compare the effectiveness of augmented reality intervention on pain among the experimental group and control group during wound dressing.
- To assess and compare the effectiveness of augmented reality intervention on comfort among the experimental group and control group during wound dressing.
- To find the correlation between pain and comfort among the experimental group and control group during wound dressing.
- To associate selected demographic variables with the level of pain among the experimental group and control group during wound dressing.
- To associate selected demographic variables with the level of comfort among the experimental group and control group during wound dressing.

Hypothesis

- **H_1:** There will be a significant difference between the mean scores of pain among the experimental group and the control group during wound dressing in children undergone abdominal surgery.
- **H_2:** There will be a significant difference between the mean scores of comfort among the experimental group and the control group during wound dressing in children undergone abdominal surgery.
- **H_3:** There will be a significant correlation between pain and comfort among the experimental group and the control group during wound dressing in children undergone abdominal surgery.

Assumption

- Wound dressing is a stressful experience for children.
- Pain during wound dressing is an inevitable response for every individual.
- Pain experience is influenced by personal factors.
- Pain and comfort vary from one child to another child.
- Wound dressing induces pain and reduces comfort among children

Delimitation

The present study was delimited to

- Children in one selected hospital.
- Assessment of pain and comfort only on the 1st and 2nd postoperative days.
- Children aged 5-12 years who have undergone abdominal surgery

Methodology

The study was done to assess the effectiveness of augmented reality intervention on pain and comfort during wound dressing among children aged 5-12 years who have undergone abdominal surgery at the Masonic Medical Centre for Children in Coimbatore. The conceptual framework used in the study was Roy's Adaptation Model (1996), which focuses on helping individuals adapt to changes in physiological needs, self-concept, and role functions. A quantitative evaluation approach with a quasi-experimental post-test-only control group design was adopted. A non-probability purposive sampling technique was used to include 50 children, 25 in the experimental group to receive the AR intervention, and 25 in the control group. The data collection tool and technique involved an interview schedule for demographic data, bio-physiological parameters measured by a pediatric cardiac monitor, the Children's and Infants' Postoperative Pain Scale (CHIPPS) for pain assessment, and a modified comfort scale for comfort assessment. The AR intervention, involved a 10-minute Pokémon game during wound dressing on the 1st and 2nd postoperative days, and the effectiveness was evaluated by observing children's pain reactions, comfort levels, and bio-physiological parameters. Tools' validity was ensured through expert feedback and reliability by the inter-rater method. A pilot study was done to confirm the feasibility, prior to the main study. Ethical considerations included obtaining ethical clearance from the Institutional Ethical Committee, formal written permission from hospital authorities, informed consent from the children and their

parents and privacy and confidentiality were maintained throughout the study. Data were analyzed using descriptive and inferential statistics, including t-test, chi-square test, and Pearson correlation by SPSS software.

Results

The study's findings from the demographic characteristics of the children which were presented in relation to personal characteristics and health-related information. In the aspect of personal characteristics, nearly one-third of the children 8 (32.0%) in both the experimental and control groups were aged between 11-12 years and were in 6th or 7th standard. Most of the children in both the experimental group 17 (68.0%) and control group 20 (80.0%) were males. Regarding siblings, nearly half of the children in the experimental group 12 (48.0%), and most of the children in the control group 16 (64.0%) had one sibling. The majority of children in the experimental group 23(92.0%) and all children in the control group 25 (100%) were non-vegetarians. In terms of hospital-related information, most of the children in the experimental group 20 (80.0%) and control group 19 (76.0%) had no previous history of hospitalization, remaining among those with a history of hospitalization, had either viral fever, dengue fever, or vomiting and diarrhea. Regarding previous surgeries, 23 (92.0%) in the experimental group and 24 (96.0%) in the control group had no history of surgery. In the aspect of the type of surgery, more than half of the children in the experimental group 14 (56.0%) and control group 15 (60.0%) had appendectomies. Most of the children in the experimental group 15 (60.0%) and control group 19 (76.0%) underwent emergency surgeries and all the children 25(100%) in both groups reported feeling scared of the wound dressing

The study's findings from the clinical data such as oxygen saturation, pulse rate, and respiratory rate. Before the intervention, the mean oxygen saturation was 99.06 in the experimental group and 99.16 in the control group. After the intervention, these values were 98.94 and 99.12, respectively, with p-values of 0.464 before and 0.308 after, indicating no significant differences between the groups at the $p \leq 0.05$ level. The mean pulse rate before the intervention was 91.16 in the experimental group and 94.72 in the control group, changing to 91.40 and 95.98 after the intervention, with p-values of 0.066 before and 0.006 after, showing no significant difference before the intervention but a significant difference was observed after the intervention, with the control group exhibiting a higher pulse rate after wound dressing. The mean respiratory rate before the intervention was 20.08 in the experimental group and 20.64 in the control group, and after the intervention, these rates were 20.32 and 21.80, respectively, with p-values of 0.087 before and 0.001 after, indicating no significant difference before the intervention but a significant difference observed after the intervention, with the control group showing an increased respiratory rate. These findings indicate that the augmented reality (AR) intervention did not increase the pulse and respiratory rates in the experimental group after wound dressing, whereas the control group, which did not receive the AR intervention, showed slight increases in both rates following wound dressing, which highlights the effectiveness of AR intervention in managing physiological responses during procedures.

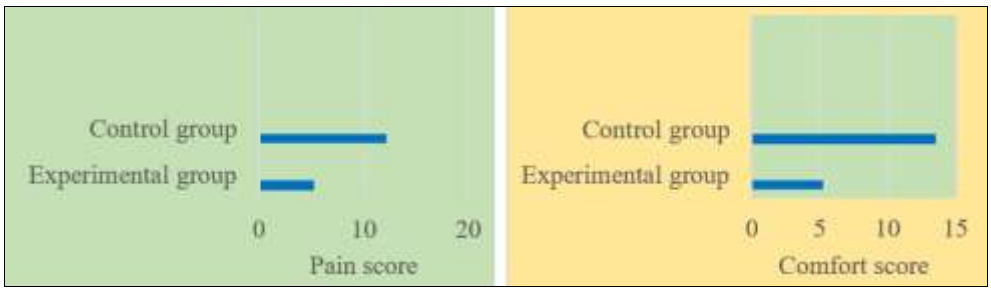

Fig 1: Presents the comparison of mean pain score and comfort score during wound dressing between the experimental group and control group

- There was a significant difference between the mean scores of pain among the experimental group and the control group during wound dressing in children undergone abdominal surgery. (t=27.634, df=48, $p<0.05$)
- There was a significant difference between the mean scores of comfort among the experimental group and the control group during wound dressing in children undergone abdominal surgery. .(t=26.008, df=48, $p<0.05$)

In the experimental group, pain and comfort had the correlation coefficient 0.847, reflecting a strong positive correlation. The significance value was 0.000, indicating that this correlation was statistically significant. The control group also had a moderate positive correlation of 0.530, which was also statistically significant with a p-value of 0.006. The findings underscore that the augmented reality intervention in the experimental group was effective in significantly improving the comfort level, which correspondingly showed a strong relation with reduced pain levels.

The association between level of pain and comfort with selected demographic variables illustrates that in the control group, there was a significant association between the degree of pain and the child's age, education level, and type of surgery.

Discussion

The results were supported by a study conducted by Michelle W. Miu *et al.* (2019) [17], which aimed to determine whether comfort and pain scores correlate when assessing patients postoperatively at the same time point. Their study found a correlation of 0.62 between pain and inverted comfort scores (95% CI 0.47–0.72; P < 0.0001), highlighting that comfort and pain scores were significantly

moderately correlated. Additionally, these findings align with a descriptive analytic study by Kevser Karacabay *et al*. (2022) [18], which investigated the relationships between pain, comfort, anxiety, and depression in surgical patients. The study revealed that patients had a mean pain score of 3.46±1.71 and a mean comfort score of 4.27±0.59, with a negative correlation between comfort and pain levels. The study concluded that patient's pain levels were low and their comfort levels were good, suggesting that effective pain control positively contributes to reducing anxiety and depression, thereby improving comfort during the postoperative period.

Conclusion

Wound dressing is a painful procedure for children post-operative period during hospitalization. The study concludes that augmented reality intervention (AR) is a highly effective non-pharmacological intervention for managing pain and enhancing comfort during wound dressing in children following abdominal surgery. The AR intervention significantly reduced pain and increased comfort levels compared to standard care, demonstrating notable improvements in both pain scores and comfort levels among the experimental group. The strong correlation between pain and comfort in the experimental group, along with the observed benefits in physiological indicators such as pulse and respiratory rates, further supports the efficacy of AR intervention. These findings highlight that AR has the potential to significantly improve the pediatric postoperative experience, making it a valuable tool for enhancing patient satisfaction and well-being during medical procedures.

Limitation

The limitations of this study were

- Due to the time-bound nature of the study, the sample size was small
- Samples were selected using purposive sampling techniques.
- Limited review studies on AR intervention and wound dressing following abdominal surgery in children
- The data was based on observation, potentially affect the accuracy of the results.

Implication

The study has significant implications across nursing practice, education, administration, and research. The study emphasizes the integration of AR intervention into standard nursing practice for pediatric patients undergoing wound care. Nurse educators should organize and implement short-term in-service programs to update nurses' knowledge and skills on effective pain management strategies. Nursing administrators should plan and organize in-service education and training on non-pharmacological pain relief methods. The study emphasizes the need to develop and implement nursing protocols that include distraction techniques, which will standardize pain management practices and improve patient comfort during wound dressing procedures. The study emphasizes the need for further research to expand the evidence base for AR interventions and explore their benefits in pediatric care. Nurse researchers should encourage clinical nurses to apply these findings and contribute to evidence-based practice.

Recommendations

The findings of the study, propose the following recommendations

- Replicate the study with a larger sample size in different settings to validate and generalize the findings.
- Conduct a study to assess the effectiveness of augmented reality (AR) interventions in reducing anxiety during wound dressing among children who have undergone abdominal surgery.
- Conduct a study to explore the effects of AR interventions on pain and comfort in children during wound dressing for other surgical procedures.
- Conduct a study to compare the effectiveness of AR interventions with other distraction techniques in managing pain and comfort during wound dressing among children who have undergone abdominal surgery.

Conflict of Interest

Not available

Financial Support

Not available

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