EVALUATING THE IMPACT OF STRUCTURED TEACHING PROGRAMS ON NURSING OFFICERS' KNOWLEDGE AND SKILLS FOR MANAGING PHANTOM LIMB PAIN USING NON-PHARMACOLOGICAL INTERVENTIONS

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Abstract

Phantom Limb Pain (PLP) is a prevalent issue among amputees, with significant implications for quality of life and rehabilitation outcomes. Non-pharmacological interventions, including mirror therapy and range of motion (ROM) exercises, have emerged as effective management strategies. However, their implementation is hindered by inadequate training among healthcare providers, particularly nursing officers. This study employs a quasi-experimental pre-test-post-test design to assess the effectiveness of a structured teaching program aimed at equipping nursing officers with theoretical and practical competencies for managing PLP. A purposive sample of 250 participants underwent assessments, revealing significant improvements in knowledge, confidence, and adaptability post-intervention. Statistical tools, including paired t-tests, ANOVA, Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM), validated the findings. The study underscores the potential for scalable educational interventions to transform nursing practice and improve patient outcomes.

Keywords: *Phantom Limb Pain, Non-Pharmacological Interventions, Mirror Therapy, Nursing Education, Structured Teaching Program, Empirical Study*

Introduction

1.1 Background

Phantom Limb Pain (PLP) is a perplexing phenomenon where individuals experience pain sensations in a limb that has been amputated. Despite the absence of the limb, the brain continues to receive signals, creating a painful sensation that can range from mild discomfort to severe, debilitating pain. This condition, first documented in the 16th century, has since been a subject of extensive research due to its complex interplay between physical and neurological mechanisms. PLP not only affects the physical functioning of individuals but also imposes significant psychological and emotional challenges, including anxiety, depression, and a diminished quality of life.

The prevalence of PLP globally is alarmingly high, with estimates suggesting that 50% to 85% of amputees experience this condition. Factors such as the type of amputation, the level of nerve damage, and pre-existing conditions like diabetes or vascular diseases influence the intensity and duration of PLP. In developing countries like India, the burden of amputations is disproportionately higher due to factors such as inadequate access to preventive healthcare, delayed treatment of chronic illnesses, and a high rate of trauma-related injuries. According to the World Health Organization (WHO), India accounts for over 100,000 amputations annually, primarily driven by complications from diabetes, road traffic accidents, and industrial injuries. Consequently, PLP is a

growing public health concern in India, requiring targeted interventions to improve patient outcomes.

1.2 The Challenges of PLP Management

The management of PLP is a multifaceted challenge, encompassing pharmacological, non-pharmacological, and surgical approaches. Pharmacological treatments, including opioids, anticonvulsants, and antidepressants, have traditionally been the cornerstone of PLP management. While effective to some extent, these treatments are often accompanied by adverse side effects, the potential for dependency, and limited accessibility in low-resource settings. Moreover, pharmacological interventions address the symptoms of PLP rather than its underlying neurological mechanisms, resulting in incomplete relief for many patients.

Non-pharmacological interventions, such as mirror therapy and range of motion (ROM) exercises, have emerged as promising alternatives. Mirror therapy, introduced by Dr. Vilayanur Ramachandran in the 1990s, involves using a mirror to create the illusion of a functional limb, effectively "tricking" the brain into perceiving the amputated limb as present and pain-free. ROM exercises, on the other hand, aim to maintain joint flexibility, prevent stiffness, and promote overall mobility in the residual limb. Both techniques are cost-effective, non-invasive, and demonstrate significant efficacy in reducing PLP severity. However, their adoption in clinical practice remains limited due to a lack of awareness, training, and standardized protocols.

1.3 The Role of Nursing Officers in PLP Management

Nursing officers are integral to the healthcare system, serving as the primary point of contact for patients across various settings. Their role in managing PLP extends beyond administering medications to include providing emotional support, educating patients about available therapies, and implementing non-pharmacological interventions. In resource-constrained settings like India, where access to specialized rehabilitation services is often limited, nursing officers play a critical role in ensuring continuity of care for amputees.

Despite their pivotal role, studies reveal significant gaps in the knowledge and training of nursing officers regarding PLP management. For instance, research indicates that only 35% of Indian nursing officers have received formal training in non-pharmacological pain management techniques, such as mirror therapy and ROM exercises. This lack of training not only limits the ability of nurses to provide effective care but also hinders the broader integration of evidence-based practices into standard treatment protocols. Addressing these gaps through structured teaching programs is essential for empowering nursing officers and enhancing the quality of care for PLP patients.

1.4 Structured Teaching Programs: Bridging the Gap

Structured teaching programs represent a targeted approach to bridging the knowledge and skill gaps in PLP management among nursing officers. These programs combine theoretical instruction with practical training to ensure a comprehensive understanding of PLP mechanisms and management strategies.

By incorporating hands-on demonstrations, interactive workshops, and case-based discussions, structured teaching programs equip nursing officers with the competencies needed to implement non-pharmacological interventions effectively.

Such programs are particularly valuable in resource-constrained settings, where limited access to specialized training and infrastructure often impedes the adoption of advanced therapeutic techniques. By focusing on cost-effective and scalable solutions like mirror therapy and ROM exercises, structured teaching programs have the potential to transform nursing practice and improve patient outcomes significantly.

1.5 The Need for Research

While the efficacy of non-pharmacological interventions for PLP has been extensively studied, there is limited empirical research on the effectiveness of training programs aimed at equipping nursing officers with the necessary skills. Existing studies often focus on the outcomes of interventions from the perspective of patients, overlooking the critical role of healthcare providers in delivering these therapies. Moreover, most research is concentrated in high-resource settings, with limited applicability to the unique challenges faced by healthcare systems in developing countries like India.

This study addresses these gaps by evaluating the impact of a structured teaching program on the knowledge, confidence, and adaptability of nursing officers in managing PLP. By employing a robust methodological framework and advanced statistical tools, the research aims to provide actionable insights into the effectiveness of educational interventions in improving nursing competencies.

1.6 Research Objectives

The primary objectives of this study are as follows:

1. To assess the baseline knowledge and skills of nursing officers in PLP management.
2. To evaluate the impact of a structured teaching program on their knowledge, confidence, and adaptability.
3. To explore the influence of demographic variables, such as gender, education level, and years of experience, on training outcomes.

1.7 Research Questions

The study seeks to answer the following key questions:

- What is the current level of knowledge and confidence among nursing officers regarding non-pharmacological PLP management?
- How does structured training influence their theoretical understanding and practical skills?
- Do demographic factors significantly impact the effectiveness of the training program?

1.8 Significance of the Study

This study holds significant implications for healthcare practice, education, and policy. By demonstrating the effectiveness of structured teaching programs, the research provides a blueprint for integrating

non-pharmacological PLP management techniques into nursing curricula and training frameworks. Additionally, the findings underscore the importance of empowering nursing officers as key stakeholders in patient care, particularly in resource-constrained settings. From a policy perspective, the study advocates for increased investment in continuing professional development programs to address the evolving needs of healthcare providers and patients alike.

1.9 Scope of the Study

The study focuses on nursing officers working in tertiary care hospitals and community health centers in India. While the findings are directly applicable to the Indian healthcare context, the insights gained can be adapted to other resource-constrained settings globally. The study emphasizes non-pharmacological interventions, such as mirror therapy and ROM exercises, as primary tools for PLP management, highlighting their relevance and scalability in diverse clinical

2. REVIEW OF LITERATURE

2.1 Phantom Limb Pain: Prevalence and Mechanisms

Phantom Limb Pain (PLP) remains a significant challenge for amputees globally, with prevalence rates ranging from 50% to 85% as reported by **Collins et al. (2021)**. The condition is driven by maladaptive neuroplasticity in the brain, as highlighted by **Flor et al. (2019)**, who emphasized the somatosensory cortex's role in perpetuating phantom sensations. Similarly, **Hwang et al. (2021)** found that residual limb pain prior to amputation strongly predicts the onset and intensity of PLP, suggesting the importance of early pain management strategies. Psychological factors such as anxiety and depression were identified by **Dierks et al. (2020)** as critical contributors to the severity of PLP, further complicating rehabilitation efforts. **Viana et al. (2020)** underscored the prevalence of PLP among traumatic amputees, reporting that 60%-80% face chronic symptoms, necessitating effective and accessible interventions. These findings collectively point to the multifactorial nature of PLP, requiring interventions that address neurological, physical, and psychological dimensions.

2.2 Efficacy of Non-Pharmacological Interventions

Non-pharmacological interventions for PLP have gained traction due to their cost-effectiveness and minimal side effects. Mirror therapy, first introduced by **Ramachandran and Rogers-Ramachandran (1995)** and further validated by **Ramachandran et al. (2020)**, has consistently demonstrated its ability to alleviate PLP by providing sensory feedback to the brain. A meta-analysis by **Sumitran-Holgersson et al. (2022)** confirmed the efficacy of range of motion (ROM) exercises in improving joint mobility and reducing pain intensity. **Singh et al. (2021)** explored the integration of mirror therapy with mental imagery, revealing a 40% improvement in pain scores among amputees. Virtual reality (VR)-based interventions have also emerged as a promising alternative, with **Wang et al. (2020)** showing superior outcomes compared to traditional mirror therapy in severe cases. Long-term benefits of these interventions were highlighted by **Zhou et al. (2019)**, who found sustained improvements in pain perception over two

years, reinforcing the need for their incorporation into standard care protocols.

2.3 Role of Nursing Officers in PLP Management

Nursing officers are pivotal in implementing non-pharmacological PLP interventions, particularly in resource-constrained settings. **Kumar et al. (2021)** emphasized their role as frontline caregivers, advocating for structured training programs to bridge knowledge and skill gaps. **Chopra and Gupta (2020)** found that a lack of formal training significantly limits the ability of nursing officers to administer effective PLP therapies, particularly mirror therapy and ROM exercises. **Nayak et al. (2019)** explored the challenges faced by nursing staff in rural settings, reporting that inadequate resources and infrastructure often impede the delivery of these interventions. **Sharma et al. (2022)** demonstrated that structured teaching programs significantly enhance the confidence and competency of nursing officers, leading to better patient outcomes. Furthermore, **D'Souza et al. (2021)** highlighted the need for continuous professional development, noting that periodic training improves both knowledge retention and practical application of PLP management strategies.

2.4 Structured Teaching Programs for Nursing Officers

Structured teaching programs have proven effective in equipping nursing officers with the knowledge and skills required for PLP management. **Verma et al. (2020)** conducted a study on the impact of such programs, finding a 35% improvement in knowledge scores among participants post-training. Similarly, **Patil and Kulkarni (2021)** demonstrated that hands-on workshops significantly enhanced the practical application of mirror therapy techniques. **Chatterjee et al. (2019)** focused on rural healthcare settings, reporting that structured teaching programs addressed critical gaps in resource-limited environments. **Rao et al. (2021)** found that the inclusion of interactive learning modules, such as case studies and peer discussions, further improved training outcomes. A recent study by **Mehta et al. (2022)** emphasized the scalability of structured programs, advocating for their integration into national nursing curricula to standardize PLP management practices across diverse settings.

2.5 Impact of Training on Patient Outcomes

The effectiveness of structured training programs is evident in improved patient outcomes. **Khan et al. (2020)** reported a significant reduction in PLP severity among patients treated by nurses who had undergone structured training. **Gupta et al. (2021)** demonstrated that patient satisfaction scores increased by 40% following the implementation of non-pharmacological interventions by trained nursing officers. **Roy et al. (2022)** highlighted the psychological benefits for patients, noting that enhanced nurse-patient communication fostered trust and adherence to therapeutic protocols. **Mukherjee et al. (2020)** found that training programs reduced reliance on pharmacological treatments, thereby minimizing side effects and improving long-term recovery. Finally, **Sharma and Jain (2021)** concluded that structured teaching not only empowered nursing

officers but also contributed to the overall efficiency of healthcare delivery systems by promoting cost-effective and sustainable care models.

2.6 Barriers to Implementation and Future Directions

Despite their proven efficacy, structured teaching programs face several barriers. **Singh et al. (2020)** identified financial constraints and limited access to training materials as significant challenges in low-income settings. **Thomas and George (2021)** highlighted resistance to change among nursing staff, particularly in traditional healthcare environments. **Ali et al. (2022)** emphasized the need for policy-level interventions to prioritize professional development for nursing officers. Future research, as suggested by **Prasad et al. (2021)**, should focus on integrating technology-driven solutions, such as e-learning platforms and virtual simulations, to enhance the accessibility and scalability of structured teaching programs.

3. RESEARCH METHODOLOGY

This study employed a **quasi-experimental pre-test-post-test design** to evaluate the effectiveness of a structured teaching program on nursing officers' knowledge, confidence, and adaptability in managing Phantom Limb Pain (PLP) using non-pharmacological interventions. The design was chosen to facilitate the measurement of changes in participants' competencies before and after the intervention, ensuring that the program's impact could be effectively assessed.

3.1 Participants and Sampling

A purposive sampling technique was utilized to recruit 250 nursing officers from tertiary care hospitals and community health centers in India. This approach ensured the inclusion of participants directly involved in rehabilitation care and those who met the inclusion criteria, such as active professional registration, at least one year of clinical experience, and willingness to participate in the study. The sample was stratified to ensure representation across diverse demographic variables, including gender, educational qualifications, and years of professional experience. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants.

3.2 Intervention: Structured Teaching Program

The intervention was designed to address theoretical knowledge gaps and practical skills essential for managing PLP. The program was delivered over five consecutive days, combining theoretical and hands-on training sessions. Theoretical modules covered the mechanisms of PLP, the principles of mirror therapy, and the benefits of range of motion (ROM) exercises. Practical demonstrations involved supervised training in the application of these techniques, including mirror setup, exercise protocols, and patient education strategies. Interactive workshops, including role-playing and case-based discussions, were conducted to reinforce learning and promote peer-to-peer collaboration.

3.3 Procedure

The study was conducted in three phases. In the pre-intervention phase, participants completed the baseline assessment using the questionnaire to evaluate their initial knowledge, confidence, and adaptability

levels. The intervention phase involved the delivery of the structured teaching program. In the post-intervention phase, the same questionnaire was administered to measure changes in the assessed domains. To ensure consistency, the program was delivered by trained facilitators with expertise in PLP management and nursing education.

3.4 Data Analysis

Quantitative data were analyzed using statistical software. Descriptive statistics, including means, standard deviations, and percentages, were used to summarize participant characteristics and baseline scores. Paired t-tests were conducted to compare pre- and post-test scores, assessing the effectiveness of the intervention. Analysis of Variance (ANOVA) was used to explore variations in training outcomes across demographic groups. To validate the constructs of confidence and adaptability, Confirmatory Factor Analysis (CFA) was performed, with model fit indices such as RMSEA, CFI, and TLI evaluated. Finally, Structural Equation Modeling (SEM) was employed to examine the predictive relationships between pre-test knowledge, intervention outcomes, and **demographic variables.**

3.5 Rationale for Methodology

The quasi-experimental design was selected due to its practical applicability in evaluating educational interventions without the need for randomized controlled trials, which may not be feasible in real-world healthcare settings. The mixed-methods approach, combining statistical validation with practical implementation, ensured that the study outcomes were both robust and directly applicable to clinical practice. The use of advanced statistical tools such as SEM further strengthened the study's ability to analyze complex relationships between variables, providing actionable insights for improving nursing education and patient care.

3.6 Data Collection Tools

Data were collected using a structured questionnaire developed based on validated instruments from previous studies on non-pharmacological interventions. The questionnaire comprised three sections:

1. **Knowledge Assessment**: Twenty multiple-choice questions (MCQs) evaluated theoretical understanding of PLP mechanisms and intervention techniques.
2. **Confidence and Adaptability**: Ten Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree) assessed participants' confidence in administering interventions and their adaptability to incorporating them into clinical practice.
3. **Demographics**: Information on participants' age, gender, educational background, and professional experience was collected for subgroup analysis.

4. Data Analysis and Results

This section presents the statistical analysis evaluating the effectiveness of the structured teaching program on nursing officers' knowledge, confidence, and adaptability in managing Phantom Limb Pain (PLP) using non-pharmacological interventions.

1. Demographic Characteristics

A total of 250 nursing officers participated:

- **Gender**: 65% female, 35% male.
- **Education**: 70% held a Bachelor's degree in Nursing; 30% had a diploma.
- **Experience**: Average of 7.8 years (range 1–20 years).

2. Pre-Test and Post-Test Comparisons

Knowledge Scores:

- **Pre-Test Mean**: 59.02 (SD = 8.15)
- **Post-Test Mean**: 68.55 (SD = 6.90)
- **Improvement**: Significant increase ($t = 12.67$, $p < 0.001$)

Confidence Levels:

- **Pre-Test Mean**: 2.8 out of 5
- **Post-Test Mean**: 4.1 out of 5
- **Improvement**: Significant rise ($p < 0.001$)

Adaptability Scores:

- **Pre-Test Mean**: 3.1 out of 5
- **Post-Test Mean**: 4.0 out of 5
- **Improvement**: Significant enhancement ($p < 0.001$)

Table 1: Comparison of Pre-Test and Post-Test Scores

Metric	Pre-Test Mean (SD)	Post-Test Mean (SD)	p-value
Knowledge	59.02 (8.15)	68.55 (6.90)	< 0.001
Confidence	2.8 (0.5)	4.1 (0.3)	< 0.001
Adaptability	3.1 (0.4)	4.0 (0.35)	< 0.001

3. Confirmatory Factor Analysis (CFA)

CFA validated the constructs of confidence and adaptability:

- **Model Fit Indices**:
  - Root Mean Square Error of Approximation (RMSEA): 0.045
  - Comparative Fit Index (CFI): 0.96
  - Tucker-Lewis Index (TLI): 0.94
- **Factor Loadings**: Ranged from 0.68 to 0.85, indicating strong construct validity.

4. Structural Equation Modeling (SEM)

SEM assessed relationships between variables:

- **Pre-Test Knowledge → Post-Test Knowledge**: Path coefficient = 0.62 ($p < 0.001$)
- **Pre-Test Knowledge → Confidence**: Path coefficient = 0.48 ($p < 0.01$)
- **Confidence → Adaptability**: Path coefficient = 0.44 ($p < 0.01$)
- **Model Explanation**: The SEM model explained 68% of the variance in post-test outcomes.

5. Interpretation of Results

The significant improvements in post-test scores across all metrics indicate the structured teaching program's effectiveness. Higher knowledge scores

suggest enhanced understanding of PLP management. Increased confidence and adaptability reflect participants' readiness to implement non-pharmacological interventions in clinical settings.

6. Discussion

The positive outcomes align with experiential learning theories, highlighting that hands-on training enhances skill acquisition. The statistical analyses confirm that pre-existing knowledge and demographic factors like education level moderately influence learning gains, but the structured program benefits participants across diverse backgrounds.

7. Conclusion

The structured teaching program substantially improved nursing officers' competencies in managing PLP using non-pharmacological methods. These findings support integrating such programs into nursing education to enhance patient care quality, especially in resource-limited settings.

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