Reducing Chemotherapy-Induced Peripheral Neuropathy and Enhancing Satisfaction through Innovative Frozen Rubber Gloves among Women with Breast Cancer: A Quasi-Experimental Study

Cholticha Thongprom, Samonnan Thasaneesuwan, Kantaporn Yodchai*

Abstract: Chemotherapy-induced peripheral neuropathy is a common and debilitating symptom experienced by women with breast cancer undergoing paclitaxel treatment. Thus, symptom relief is essential. The objective of this quasi-experimental study was to determine whether the use of Innovative Frozen Rubber Gloves could reduce chemotherapy-induced peripheral neuropathy and enhance satisfaction among women with breast cancer undergoing chemotherapy. The participants were 29 women with newly diagnosed stage I-II breast cancer who underwent four complete cycles of doxorubicin (Adriamycin®) and cyclophosphamide, followed by four cycles of a paclitaxel regimen. The study was conducted at the chemotherapy infusion center of the outpatient department of a university hospital in Southern Thailand from March 2022 to April 2023. Each participant served as her own control: one hand was designated as the experimental hand and fitted with an Innovative Frozen Rubber Glove for 90 minutes during each of the four paclitaxel infusions (15 minutes before infusion, 60 minutes during infusion, and 15 minutes after infusion). The other hand served as a control hand without the glove. The data collection instruments included the Quality-of-Life Questionnaire-Chemotherapy-Induced Peripheral Neuropathy 20 and the Chemo-Cooling Gloves Satisfaction Questionnaire. Data were analyzed using descriptive statistics and the generalized linear mixed model.

The results indicated that the Innovative Frozen Rubber Gloves significantly reduced peripheral neuropathy, particularly during cycle 3 (immediately after completing chemotherapy) and cycle 4 (14 days post-chemotherapy). The women with breast cancer reported the highest overall satisfaction with Innovative Frozen Rubber Gloves. Nurses can use Innovative Frozen Rubber Gloves as a supportive intervention to alleviate chemotherapy-induced peripheral neuropathy associated with the paclitaxel regimen. However, further study in a larger sample size is needed.

Keywords: Breast cancer, Chemotherapy-induced peripheral neuropathy, Frozen rubber gloves, Nursing innovation

Received 19 January 2025; Revised 9 May 2025; Accepted 10 May 2025

***Cholticha Thongprom**, RN, BSC, Registered Nurse, Professional Level, Chemotherapy Center, Faculty of Medicine, Prince of Songkla University Thailand. E-mail: cholticha.t@psu.ac.th*

***Correspondence to: Samonnan Thasaneesuwan**,* RN, PhD, Assistant Professor, Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand. E-mail: samonnun.t@psu.ac.th*

***Kantaporn Yodchai**, RN, PhD, Associate Professor, Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand. E-mail: Kantaporn.y@psu.ac.th*

Author contributions:

CT: Conceptualization, method and design, tool development, data collection, and final approval of the submitted version

ST: Conceptualization, method and design, validating tools, assisting in data analysis and interpretation, drafting and revising the manuscript, corresponding author, and final approval of the submitted version

KY: Conceptualization, method and design, data interpretation, revising the manuscript, and final approval of the submitted version

https://doi.org/10.60099/prijnr.2025.273221

Introduction

Breast cancer is a prevalent global health issue among women. In Thailand, it has consistently ranked as the most common cancer among women.[1-3] Standard treatments employed to alleviate symptoms, impede disease progression, and enhance quality of life encompass chemotherapy, surgery, radiation therapy, and targeted therapy. While chemotherapy is recognized as a crucial tool for surviving the disease, its use in women with breast cancer often leads to adverse effects affecting various bodily systems. One commonly prescribed regimen for breast cancer is paclitaxel, widely known by its brand name of Taxol. The paclitaxel chemotherapy regimen is employed in both early and advanced stages of the disease. It may be used in adjuvant or neoadjuvant chemotherapy to diminish tumor size prior to surgical intervention. The standard regimen consists of four cycles combined with chemotherapeutic agents such as doxorubicin and cyclophosphamide.[4] The adverse effects of the paclitaxel regimen may jeopardize quality of life in women with breast cancer, including chemotherapy-induced peripheral neuropathy (CIPN).[4]

CIPN is a notable side effect that can substantially impact daily activities.[5] CIPN symptoms may appear within the first month of chemotherapy and then lessen. In terms of prevalence, Salehifar et al.[6] studied CIPN symptoms including paresthesia, redness, and tingling in the fingers in women with breast cancer, finding that 23.7% (84 patients) experienced CIPN, which significantly impacted quality of life.

Based on the literature review, the management of CIPN involves various methods to prevent and reduce symptoms.[7-8] These include pharmacological and non-pharmacological approaches, which can delay or prevent the severity of these symptoms.[7-8] However, several limitations were identified, including cold intolerance,[9-10] a small sample size,[11] short measurement times,[10-12] potential selection bias,[12] and issues with the consensus of the findings.[13] Additionally, the effectiveness in terms of cost and outcomes was not fully explored, particularly in countries where medical devices are limited. This limitation prompted the researchers to recommend further studies to enhance the success of these interventions. Therefore, innovative nursing care for CIPN management is crucial for alleviating symptom burden and promoting quality of life in women with breast cancer. Thus, this study intended to use Innovative Frozen Rubber Gloves (IFRGs), which utilize the beneficial mechanism of cryotherapy,[14] to reduce the harmful effects of chemotherapy-induced peripheral neuropathy among women with breast cancer undergoing the taxane-chemotherapy regimen.

Conceptual Framework and Literature Review

This study integrated physiological mechanisms, pharmacological knowledge of paclitaxel, and material science related to applying novel frozen rubber foam to mitigate CIPN symptoms as a framework. The physiological mechanisms refer to the effects of chemotherapy agents on the peripheral nervous system, particularly in women with breast cancer. Paclitaxel, a taxane-based chemotherapy, induced CIPN by "interfering with microtubules function, modifying ion channel behavior, and increasing the excitability of peripheral neurons."[15(p.4669)] Moreover, neuroinflammation—characterized by the activation of microglia and astrocytes, nociceptor sensitization, and mitochondrial DNA damage—further contributes to the condition.[15-16] These physiological alterations contribute to the development of chemotherapy-induced peripheral neuropathy, which manifests as numbness, tingling, pain, and weakness, especially in the hands and feet.[16] In addition, several factors have been identified as influencing the severity of CIPN, including age,[17] psychological distress,[18] and initial diagnosis of malignancy. Therefore, providing effective nursing management for these symptoms presents a significant challenge in the context of cancer treatment.

Previous studies on the management of CIPN, including physical activity or exercise,[19] acupuncture,[20] yoga,[21] compression,[22] and particularly cryotherapy,[11,23-26] have been found to delay or prevent the severity of these symptoms. Cryotherapy is a strategy that utilizes the vasoconstriction mechanism to mitigate the adverse effects of taxane-based chemotherapy, resulting in limited chemotherapy delivery to distal peripheral nerves.[5] The evidence-based practice of cryotherapy has proven promising outcomes in reducing CIPN.[12-13,27] Current research indicates that the application of Elasto-Gel frozen gloves/socks, maintained at a temperature between -20°C to -10°C, 15 minutes before, 60 minutes during, and 15 minutes following chemotherapy infusion (total 90 minutes) has demonstrated effectiveness in mitigating CIPN. However, several limitations have been identified, including a dropout rate exceeding 30% due to intolerance of the cooling temperature,[10] a limited sample size,[11] short measurement periods,[11-12] potential selection bias,[12] and the absence of conclusive findings regarding the application of cooling gloves.[13] Therefore, there is a need to develop innovative, cost-effective cryotherapy tools grounded in evidence-based practice.

In a study by Yodchai et al.,[29] Chemo-Cooling Gloves (CCGs) were developed by the research team using natural rubber foam, which effectively maintained a target temperature (-10°C to 10°C) for the duration required during chemotherapy infusion. Consistent and sustained cooling is crucial to achieving effective vasoconstriction and is a key feature of this novel frozen glove design. The CCGs were found to reduce skin temperature more effectively and more rapidly than conventional cold gel packs. Furthermore, the CCGs were well-accepted by women with breast cancer and contributed to a reduction in nail toxicity during chemotherapy by the mechanism of vasoconstriction as a tactic for reducing nail toxicity. Consequently, our research team aimed to thoroughly assess the efficacy of Chemo-Cooling Gloves (CCGs) developed by Yodchai et al.,[29] (used with permission), in the form of IFRGs, for mitigating CIPN through their cooling mechanism and user-friendly design, to enhance satisfaction among women with breast cancer undergoing a taxane-based regimen.

Study Aim and Hypotheses

This study aimed to compare the mean scores of CIPN between the hand with IFRG and the other hand without IFRG, and satisfaction with IFRG among women with breast cancer receiving chemotherapy. The hypotheses were that the mean scores of CIPN for the hand with IFRG would be significantly lower than those for the hand without IFRG, and that participants would have a high level of satisfaction with IFRG.

Methods

Design: This study used a self-controlled case series method, utilizing a quasi-experimental approach with a two-group pretest-posttest design. The Transparent Reporting of Evaluation with Nonrandomized Designs (TREND) statement checklist guided this report with a checklist for a quasi-experimental study design.

Sample and Setting: The participants were recruited from a chemotherapy center at a tertiary hospital in southern Thailand. The inclusion criteria were: 1) age greater than 18 years; 2) women newly diagnosed with breast cancer completing four full cycles of the AC regimen (doxorubicin or Adriamycin® and cyclophosphamide), followed by an additional four cycles of paclitaxel chemotherapy; 3) proficient communication in Thai; and 4) Hospital Anxiety Distress scores (HADs) within a range of 0-7.[30] The HADs within this range was used to control for psychological distress, which has been identified as a contributing factor to the severity of CIPN in women with breast cancer.[14] The exclusion criteria were: failure to complete the four-cycle chemotherapy treatment; experience of Raynaud's phenomenon and an inability to tolerate

cooling; manifestation of side effects from chemotherapy; and transfer to another chemotherapy center.

Sampling Method: A random assignment was used to allocate the participants' two hands to the intervention group (with IFRG) and control group (without IFRG). The sample size calculation utilizing the power analysis method was employed based on a prior study by Chitkumarn et al.[31] with an effect size (d) of 0.65, a confidence level of 95% ($\alpha = 0.05$), and a power analysis result of 0.80.[32] The initial sample size was computed to be 29.

Additionally, the self-controlled case method was employed to control for confounding factors, such as age, quantity of subcutaneous fat, and health status,[33] which might have caused temperature changes in the cold compresses. During the IFRG intervention, there were no case dropouts, nor complications, such as redness and intolerance to cooling. A total of 29 participants (58 hands) were included in the study.

Ethical Considerations: The study received ethical approval from the Human Research Ethics Committee of the Faculty of Medicine, Prince of Songkla University (No. REC.66-032-15-7, dated March 17, 2023) and the hospital, which was the setting for the study. Before starting the data collection process, the principal investigator (PI) met with the participants who fulfilled the inclusion criteria. The PI informed the participants about the study's aims and methods, then requested them to voluntarily participate by signing informed consent forms. The researchers also declared that their decision to either participate or not participate in the research study would not affect their access to healthcare services. We ensured the strict confidentiality of all data and limited its use to academic purposes. The participants could also withdraw from the study at any time, with a guarantee that there would be no consequences affecting their healthcare services or treatment plan.

Research Instruments: The study instruments comprise instruments for data collection and intervention.

Data Collection Instruments

A demographic questionnaire collects data on age, sex, religion, marital status, education level, health benefit, diagnosis, chemotherapy regimen, comorbidity, drug and allergy history, and other treatments.

The Quality-of-Life Questionnaire-Chemotherapy-Induced Peripheral Neuropathy 20 [QLQ-CIPN20), was developed by the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Group in 2005[34] and subsequently translated into Thai by Prasertsri et al.[35] The instrument assesses the symptoms occurring within the seven days prior to data collection, utilizing a 4-point Likert scale (1 = no symptoms, 2 = mild symptoms, 3 = moderate symptoms, 4 = severe symptoms). There are 20 items and as this study focused exclusively on women with breast cancer, one item related to men was excluded. Consequently, the analysis considered 19 items categorized into three domains: sensory perception (9 items, e.g., *a sensation similar to needles pricking the fingers or hands*), motor movement (8 items, e.g., *difficulty handling small objects with fingers, such as fastening small buttons)*, and autonomic sensory perception (2 items, e.g., *difficulty hearing*). The total scores ranged from 19 to 76. The instrument was validated by three experts—an oncologist, an oncology nurse, and a nursing instructor—resulting in an item-level content validity index (I-CVI) of 0.88. The original 20-item scale had a Cronbach's alpha of 0.79,[35] while the 19-item version used in the present study yielded a Cronbach's alpha of 0.98.

The Chemo-Cooling Gloves Satisfaction Questionnaire (CCG-SQ) was developed by Yodchai et al.,[29] and included 14 items categorized into three domains: 1) efficacy and usability (10 items); 2) features (3 items); and 3) overall satisfaction with the Frozen rubber gloves (1 item). The assessment utilized a 5-point Likert scale ranging from "completely dissatisfied" (Level 1) to "completely satisfied" (Level 5). The mean score for the CCG-SQ was also categorized into five levels, including highest (4.5-5.00), high (3.50-4.49),

moderate (2.50-3.49), low (1.50-2.49), and very low (1.00-1.49). The instrument was validated by three experts—an oncologist, an oncology nurse, and a nursing instructor—resulting in a S-CVI of 1.0. Its reliability was indicated by a Cronbach's alpha coefficient of 0.78.

Intervention Tools

1. Innovative Frozen Rubber Gloves (IFRGs): In this study, the term 'IFRGs' refers to intervention tools—Chemo-Cooling Gloves (CCGs)—developed by Yodchai et al.[29] with permission, utilizing natural rubber as the primary material. The IFRGs consisted of three layers: the top layer is fabric, the second layer is foam rubber sewn onto the fabric, and the third layer is bamboo cotton. The gloves can prevent direct contact between the skin, the cold source, and the foam rubber, preventing skin from irritation. While wearing the IFRG, the alcohol packs can be changed using the two-sided zipper on the exit sleeve (see **Figure 1**; image used with permission). A pilot test was conducted to ensure the safety of the IFRGs with three healthy individuals before its implementation.

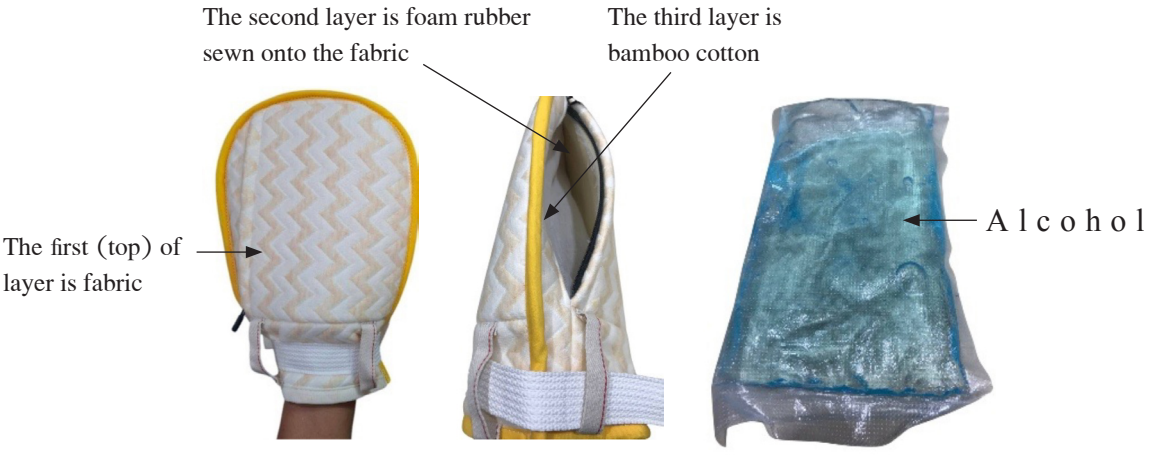

Figure 1. Innovative Frozen Rubber Gloves, with permission

2. Thermometer with a probe (PONPE 421TK—K-type Digital Thermometer). The procedure for controlling the temperature of IFRGs was very important. In this study, a digital thermometer with a probe (PONPE 421TK—K-type Digital Thermometer) was used to measure the participants' skin temperature during the intervention. These devices were calibrated by the Calibration Laboratory, which is holder of Certificate No. T0002/2023, issued by the Agro-Industry Development Center for Export, Faculty of Agro-Industry, Prince of Songkla University. In addition, the research assistants (RAs) were closely monitored during the intervention to guarantee the target temperature.

Implementation of the IFRG protocol: The protocol for participants in the experimental group (hand with IFRG) consisted of four cycles. On Day 1 (baseline), the PI met with each participant to provide a detailed explanation of the study and to administer either the IFRG or the control protocol. The participants who met the inclusion criteria completed a demographic form, a mental health status assessment, and an evaluation of the risk for cryotherapy. The PI suggested using IFRGs and randomly assigned one hand (right or left) for its application. The participant, wearing the IFRG, had previously received chemotherapy treatment lasting roughly 15 minutes (IFRG began at -10°C

and the temperature was kept within 10°C by a probe monitor). During the IFRG procedures, the RAs replaced the participants' gloves and alcohol packs every 15 minutes for a total of six times to maintain a constant temperature at -10°C to 10°C. After completion, the IFRGs were removed, and hands were evaluated for CIPN levels, which took approximately 15 minutes. During chemotherapy cycles 2-4, the PI conducted a QLQ-CIPN20 evaluation with each participant, following the same procedure in Cycle 1, which took approximately 5-10 minutes. Subsequently, the PI provided the IFRG, following the protocol established in Cycle 1. While the participants awaited the next chemotherapy cycle, the RAs continued to monitor CIPN symptoms 14 days after treatment, and evaluated CIPN, which took approximately 5-10 minutes. This process was repeated during cycles 2 through 4. After Cycle 4 concluded, the RAs assessed participant satisfaction with the innovative frozen rubber glove intervention.

The control group (hand side without IFRG) received standard care, which included assessment of CIPN symptoms and providing nursing care such as education for symptom management. If symptoms were severe, physician consultation for pharmacological therapy was provided.

Data Collection: Following ethical approval from the hospital, the PI met with the participants at the chemotherapy infusion center, where registered nurses assisted in screening the potential participants prior to commencing with the trial. The purpose, objectives, and potential benefits of the research project were communicated during this meeting. The PI trained two RAs, who were not involved in the intervention, to evaluate the outcomes during data collection from March 2022 to April 2023.

Data Analysis: R software (Version 4.3.1) was used for data analysis. Demographic data and satisfaction were analyzed using descriptive statistics, with frequency, percentage, mean, and standard deviation for continuous variables. The mean QLQ-CIPN20 scores were compared between the hands with IFRG and without IFRG at three time points (T0, T1, and T2), using a generalized linear mixed model (GLMM). Prior to conducting the GLMM, the researchers assessed the model's assumptions, including normality of residuals, homoscedasticity, random effects, and model comparison. The results indicated no significant violation.

Results

There were 29 participants; furthermore, since the participants served as their own controls, there were 29 hands with IFRGs and 29 hands without IFRGs. The age range of the participants was 30-69. Most were Buddhist, married, and reported holding a bachelor's degree as their highest level of education (see **Table 1**).

Table 1. Demographic characteristics (N = 29)

Demographics	**N (%)**
Age Min = 30, Max = 69, Mean = 55.86 (SD = 9.43)	
Religion	
Buddhist	26 (89.7)
Muslim	3 (10.3)
Marital status	
Single	6 (20.7
Married	22 (75.9)
Divorced	1 (3.4)

Table 1. Demographic characteristics (N = 29) (Cont.)

Demographics	N (%)
Educational level	
Elementary	5 (17.2)
Grades 1-6	5 (17.2)
Grades 9-12	3 (10.3)
Bachelor's degree	16 (55.2)
Health benefits	
Universal Coverage	3 (10.3)
Civil Service Medical Benefits	21 (72.4)
Social security	4 (13.8)
Out of pocket	1 (3.4)
Comorbidity	
None	14 (48.3)
Dyslipidemia	7 (24.1)
Hypertension	3 (10.3)
DM	1 (3.4)
Migraines	1 (3.4)
Asthma	1 (3.4)
Allergies	1 (3.4)
Thyroid cancer	1 (3.4)
Drug and food allergies	
Yes	5 (17.2)
No	24 (82.8)
Stage of breast cancer	
Stage 1	7 (24.1)
Stage 2	22 (75.9)
Treatment	
Chemotherapy	8 (27.6)
Surgery and chemotherapy	21 (72.4)

The results from the GLMM demonstrated that at Cycle 3 (immediately after chemotherapy) and Cycle 4 (14 days post-chemotherapy), the mean score from the QLQ-CIPN20 of the hand with an IFRG was significantly lower than the hand without the IFRG ($p = 0.039$ and 0.032, respectively). Other time points showed no significant differences between the two groups (see **Table 2** and **Figure 2**).

Table 2. Comparison of the changes in mean scores of CIPN over time from baseline between the hands with IFRGs and without IFRGs in each cycle using the generalized linear mixed-effects model (N = 29)

Times	With IFRGs	Without IFRGs	t-value	p-value
	Mean ± SD	Mean ± SD		
Cycle 1				
Baseline	18.1 ± 0.4	18.1 ± 0.4		
Immediately after completing chemotherapy	18.1 ± 0.3	18.2 ± 0.6	-0.245	0.806
14 Days after completing chemotherapy	20.6 ± 2.0	20.8 ± 2.2	-0.409	0.683

Table 2. Comparison of the changes in mean scores of CIPN over time from baseline between the hands with IFRGs and without IFRGs in each cycle using the generalized linear mixed-effects model (N = 29) (Cont.)

Times	With IFRGs	Without IFRGs	t-value	p-value
	Mean ± SD	Mean ± SD		
Cycle 2				
Baseline	20.6 ± 2.1	20.7 ± 2.4		
Immediately after completing chemotherapy	19.6 ± 1.4	20.3 ± 2.3	-1.247	0.214
14 Days after completing chemotherapy	21.7 ± 2.4	22.0 ± 2.7	-0.312	0.756
Cycle 3				
Baseline	21.3 ± 2.3	21.3 ± 2.6		
Immediately after completing chemotherapy	20.2 ± 2.2	21.2 ± 2.6	-2.080	0.039
14 Days after completing chemotherapy	22.1 ± 2.7	22.6 ± 2.9	-0.971	0.333
Cycle 4				
Baseline	21.7 ± 2.1	21.9 ± 2.6		
Immediately after completing chemotherapy	20.4 ± 1.9	21.4 ± 2.7	-0.536	0.593
14 Days after completing chemotherapy	25.2 ± 6.6	28.5 ± 8.8	-2.169	0.032

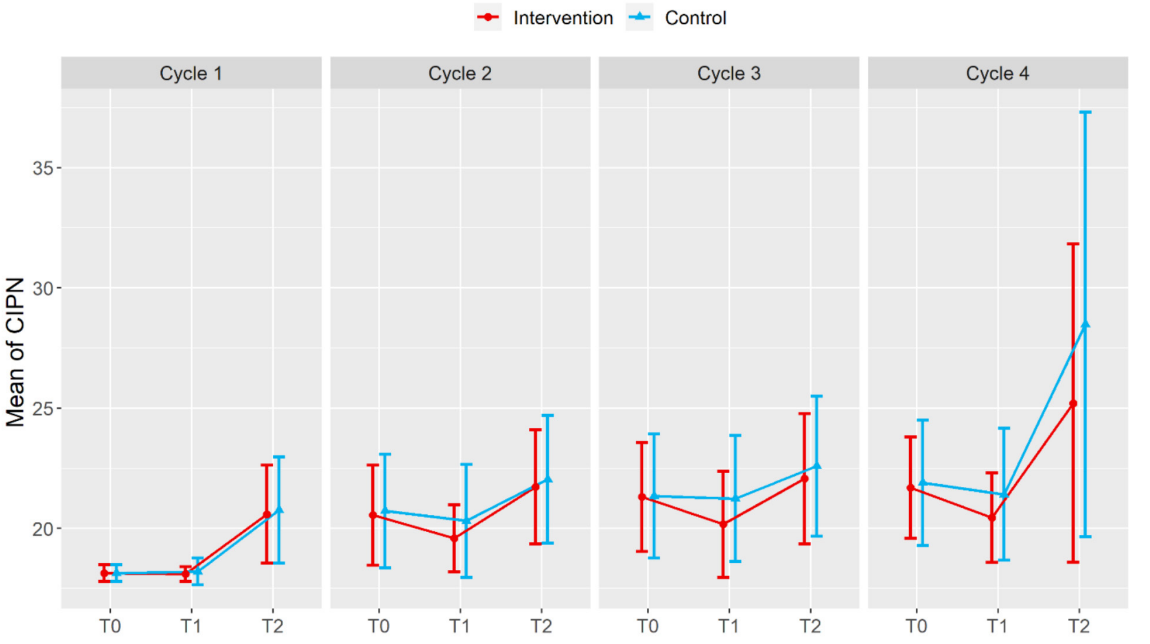

Figure 2. Comparison of the mean QLQ-CIPN20 scores from Cycle 1 to Cycle 4 at three time points: T0 (Baseline), T1 (After completing chemotherapy), and T2 (14 Days post-chemotherapy)

The overall satisfaction with the IFRG was rated at the highest level. Efficiency and usefulness demonstrated the highest level among seven items, with the glove receiving the top grade at a mean score of 4.97 for reusability and ease of movement during wear. It achieved a mean score of 4.93 for not inducing skin irritation and withstanding cold temperatures, marking the highest mean score in each category. The features of the IFRG demonstrated the highest satisfaction, including an aesthetically attractive design, ease of storage, portability convenience, and appropriate size (see **Table 3**).

Table 3. Satisfaction level of Innovative Frozen Rubber Gloves (N = 29)

Domain	Mean	SD	Level
Efficiency and usability			
1) There is no excessive moisture while wearing the frozen gloves.	4.38	0.62	High
2) There are no allergic reactions to the gloves, such as rashes or itching.	4.55	0.69	Highest
3) Using the frozen gloves does not cause skin irritation.	4.93	0.26	Highest
4) The frozen gloves can be reused.	4.97	0.19	Highest
5) There is no pain in the nails or hands.	4.45	0.69	High
6) The frozen gloves are durable and strong.	4.48	0.83	High
7) The cold temperature level is tolerable.	4.93	0.26	Highest
8) The frozen gloves can maintain cooling efficiency for a prolonged period.	4.90	0.31	Highest
9) You can move easily while wearing the frozen gloves.	4.97	0.19	Highest
10) You feel comfortable while wearing the frozen gloves.	4.90	0.31	Highest
Features			
11) The design is aesthetically pleasing.	4.83	0.38	Highest
12) The frozen gloves are easy to store and convenient for portability.	4.76	0.44	Highest
13) The size fits well and is suitable for wearing on the hands.	4.69	0.54	Highest
Overall			
14) Overall satisfaction with the frozen rubber gloves.	4.76	0.44	Highest

Discussion

Our study's findings demonstrate the effectiveness of the IFRGs in alleviating CIPN symptoms among women with newly diagnosed, early-stage breast cancer receiving paclitaxel chemotherapy, both immediately after the third cycle and 14 days after the fourth cycle, and the overall highest satisfaction with its efficiency, usability, and characteristics. This indicates the potential of the innovation to reduce CIPN symptoms in both the acute phase and the subsequent week post-infusion. The IFRG operates through vasoconstriction, which is the constriction of blood vessels in the hands induced by localized cooling. This response is thought to diminish drug perfusion to peripheral nerve endings, thereby lessening the neurotoxic effects of paclitaxel.[5] The observed effectiveness, immediately and two weeks post-treatment, indicates an early protective effect and a potentially delayed or sustained neuroprotective advantage, likely through the reduction of cumulative neurotoxicity. This finding aligns with previous research,[12] which reported that the use of frozen gloves significantly reduced the severity of CIPN in patients with breast cancer undergoing paclitaxel treatment. A systematic review on the efficacy of nonpharmacologic interventions for mitigating CIPN concluded that cryotherapy is effective.[36,37] Additionally, the ability to maintain a controlled temperature between -10°C and 10°C

for 90 minutes per session may be significant, as this range aligns with previous studies that identified target temperatures effective in inhibiting mechanisms contributing to the severity of CIPN.[11,13,38]

Interestingly, the results did not demonstrate a significant effect of IFRG on the reduction of CIPN during the first or second infusion cycle. This may be due to the relatively low level of paclitaxel toxicity at this stage. Additionally, participants may not have reported CIPN symptoms. When considering the severity of CIPN, similar levels were observed between the hand treated with IFRG and the hand without IFRG. Moreover, the accuracy of self-report CIPN level may have been limited, as participants were less capable of identifying or articulating mild neuropathic symptoms during the early phase of treatment. The significant reduction in CIPN observed during Cycles 3 and 4 may be attributed to a cumulative effect of cryotherapy or improved adherence to temperature regulation protocols in the later treatment cycles.

CIPN symptoms may persist for several months or even years following chemotherapy.[39] This persistence is likely related to the cumulative neurotoxicity of chemotherapy agents,[40] with CIPN commonly occurring at a cumulative dose of 250-300 mg/m.[2] In comparison, the doses reported in the present study reached up to 700 mg/m.[2] Additionally, several risk factors may contribute to the development of CIPN, including age over 45 years and infusion durations longer than 30 minutes.[41] In our study, the mean participant age was 55.86 years, indicating a potentially higher risk for treatment-related neurotoxicity.[5]

This study, conducted among Thai women with breast cancer, demonstrated that the use of innovative frozen rubber gloves effectively reduced CIPN levels. Furthermore, no adverse effects from the cooling intervention were reported; the participants tolerated the cold temperatures well and experienced no hand pain or allergic reactions such as rashes or itching. These outcomes contributed to the highest overall level of satisfaction with the intervention. Furthermore, the natural rubber frozen gloves represent a cost-effective, accessible, and contextually pertinent innovation, particularly beneficial for development in resource -constrained settings such as regional or rural hospitals in Thailand. Their ease of use and affordability enhance their practicality for clinical use, promoting broader initiatives to address CIPN without requiring advanced medical equipment.

Limitations

This study represents the initial investigation of IFRGs in Thai women with breast cancer. However, several limitations were identified. Notably, the study relied on a single cohort to assess the impact of the innovation and compare outcomes across women with breast cancer. Since the participants were aware of the treatment status of each hand, this awareness may have influenced the measurement of CIPN. Additionally, there was insufficient control over potential confounding variables, such as room temperature consistency and physical activity levels. Furthermore, the limited sample size restricts the generalizability of the findings.

Conclusion and Implications for Nursing Practice

The innovative application of frozen rubber gloves to mitigate CIPN symptoms demonstrated considerable patient satisfaction among women with breast cancer, particularly in terms of efficiency, usability, and features. The IFRGs enable nurses and healthcare teams to offer a promising, non-invasive approach to alleviating symptoms, enhancing the performance of activities of daily living in this population. Maintaining a target temperature of at least -10°C is critical for maximizing therapeutic effects while ensuring patient safety and comfort. Additional research with larger, multi-site sampling is necessary to verify

these findings and facilitate a more extensive implementation.

Acknowledgments

The research team expresses sincere gratitude to the study participants and the nursing staff at the chemotherapy center in Southern Thailand for their cooperation during the data collection process. We also extend our appreciation to the statistician and research assistants for their indispensable contributions to data analysis and the overall execution of the project. Special thanks are extended to Mr. Geoffrey Cox for his proficient assistance in editing the manuscript.

References

1. National Cancer Institute. Hospital-based cancer register 2022 [Internet]. 2024 Jul 25 [cited 2023 Feb 20]. Available from: https://www.nci.go.th/th/cancer_record/download/Hosbased-2022-1.pdf (in Thai).
2. National Cancer Institute. Hospital-based cancer register 2021 [Internet]. 2022 Jul 25 [cited 2023 Feb 20]. Available form: https://www.nci.go.th/th/cancer_record/download/HOSPITAL-BASED_2021.pdf (in Thai).
3. National Cancer Institute. Hospital-based cancer register 2020 [Internet]. 2021 Jul 25 [cited 2023 Feb 20]. Available form: https://www.nci.go.th/e_book/hos-based_2563/index.html (in Thai).
4. Das T, Nandy S, Pandey DK, Al-Tawaha AR, Swamy MK, Kumar V, et al. An update on paclitaxel treatment in breast cancer. Paclitaxel. 2022:287-308. doi: 10.1016/B978-0-323-90951-8.00013-8.
5. Lee KT, Bulls HW, Hoogland AI, James BW, Colon-Echevarria CB, Jim HSL. Chemotherapy-induced peripheral neuropathy (CIPN): a narrative review and proposed theoretical model. Cancers (Basel). 2024; 16(14):2571. doi: 10.3390/cancers16142571.
6. Salehifar E, Janbabaei G, Alipour A, Tabrizi N, Avan R. Taxane-induced peripheral neuropathy and quality of life in breast cancer patients. J Oncol Pharm Pract. 2020;26(6): 1421-8. doi: 10.1177/1078155219898511.
7. Di Nardo P, Lisanti C, Garutti M, Buriolla S, Alberti M, Mazzeo R, et al. Chemotherapy in patients with early breast cancer: clinical overview and management of long-term side effects. Expert Opin Drug Saf. 2022;21(11):1341-55. doi: 10.1080/14740338.2022.2151584.
8. Klafke N, Bossert J, Kröger B, Neuberger P, Heyder U, Layer M, et al. Prevention and treatment of chemotherapy-induced peripheral neuropathy (CIPN) with non-pharmacological interventions: clinical recommendations from a systematic scoping review and an expert consensus process. Med Sci (Basel). 2023;11(1):15. doi: 10.3390/medsci11010015.
9. Ronconi G, Gatto DM, Codazza S, Ariani M, Martire E, Cerretti L, et al. Conservative non-pharmacological treatments for chemotherapy-induced peripheral neuropathies in women treated for breast cancer: a systematic review. Eur J Phys Rehabil Med. 2024;60(3):505-13. doi: 10.23736/S1973-9087.24.08197-8.
10. Beijers AJM, Bonhof CS, Mols F, Ophorst J, de Vos-Geelen J, Jacobs EMG, et al. Multicenter randomized controlled trial to evaluate the efficacy and tolerability of frozen gloves for the prevention of chemotherapy-induced peripheral neuropathy. Ann Oncol. 2020;31(1):131-6. doi: 10.1016/j.annonc.2019.09.006.
11. Shigematsu H, Hirata T, Nishina M, Yasui D, Ozaki S. Cryotherapy for the prevention of weekly paclitaxel-induced peripheral adverse events in breast cancer patients. Support Care Cancer. 2020;28(10):5005-11. doi:10.1007/s00520-020-05345-9.
12. Xu M, Wang F, Zhu X, Hao Z. Efficacy of cryotherapy on chemotherapy-induced peripheral neuropathy in patients with breast cancer: a propensity score-matched study. Ann Med Surg (Lond). 2023;85(6):2695-703. doi: 10.1097/MS9.0000000000000906.
13. Ng DQ, Tan CJ, Soh BC, Tan MML, Loh SY, Tan YE, et al. Impact of cryotherapy on sensory, motor, and autonomic neuropathy in breast cancer patients receiving paclitaxel: a randomized, controlled trial. Front Neurol. 2020;11:604688. doi: 10.3389/fneur.2020.604688.
14. Leen AJ, Yap DWT, Teo CB, Tan BKJ, Molassiotis A, Ishiguro H, et al. A systematic review and meta-analysis of the effectiveness of neuroprotectants for paclitaxel-induced peripheral neuropathy. Front Oncol. 2022;11: 763229. doi: 10.3389/fonc.2021.763229.

15. Avallone A, Bimonte S, Cardone C, Cascella M, Cuomo A. Pathophysiology and therapeutic perspectives for chemotherapy-induced peripheral neuropathy. Anticancer Res. 2022;42(10):4667-78. doi: 10.21873/anticanres.15971.
16. Burgess J, Ferdousi M, Gosal D, Boon C, Matsumoto K, Marshall A, et al. Chemotherapy-induced peripheral neuropathy: epidemiology, pathomechanisms and treatment. Oncol Ther. 2021;9(2):385-450. doi: 10.1007/s40487-021-00168-y.
17. Engvall K, Gréen H, Fredriksson M, Åvall-Lundqvist E. Persistent neuropathy among early-stage breast cancer survivors in a population-based cohort. Br J Cancer. 2021;125(3):445-57. doi: 10.1038/s41416-021-01429-3.
18. Thanakun P, Jitpanya C, Pudtong N. Relationships among body mass index, medicine, anxiety, depression, physical activity, and chemotherapy-induced peripheral neuropathy in patients with breast cancer. J Health Sci BCNSP. 2021;5(1):53-67. Available from: https://he01.tci-thaijo.org/index.php/bcnsp/article/view/243651 (in Thai).
19. Saint K, Nemirovsky D, Lessing A, Chen Y, Yang M, Underwood WP, et al. Impact of exercise on chemotherapy-induced peripheral neuropathy in survivors with post-treatment primary breast cancer. Breast Cancer Res Treat. 2024;206(3):667-75. doi: 10.1007/s10549-024-07342-6.
20. Lu W, Giobbie-Hurder A, Freedman RA, Shin IM, Lin NU, Partridge A, et al. Acupuncture for chemotherapy-induced peripheral neuropathy in breast cancer survivors: a randomized controlled pilot trial. Oncologist. 2020;25(4):310-8. doi: 10.1634/theoncologist.2019-0489.
21. Bao T, Zhi I, Baser R, Hooper M, Chen C, Piulson L, et al. Yoga for chemotherapy-induced peripheral neuropathy and fall risk: a randomized controlled trial. JNCI Cancer Spectr. 2020;4(6):pkaa048. doi:10.1093/jncics/pkaa048.
22. Kang YJ, Yoon CI, Yang YJ, Baek JM, Kim YS, Jeon YW, et al. A randomized controlled trial using surgical gloves to prevent chemotherapy-induced peripheral neuropathy by paclitaxel in breast cancer patients (AIUR trial). BMC Cancer. 2023;23(1):570. doi: 10.1186/s12885-023-11079-8.
23. Bailey AG, Brown JN, Hammond JM. Cryotherapy for the prevention of chemotherapy-induced peripheral neuropathy: a systematic review. J Oncol Pharm Pract. 2021;27(1):156-64.doi:10.1177/1078155220959431.
24. Jue MY, Shah D, Stiles A, Nisar T. Impact of cold therapy on paclitaxel-induced peripheral neuropathy and quality of life in patients with breast cancer. Clin J Oncol Nurs. 2022;26(1):93-9. doi: 10.1188/22.CJON.93-99.
25. Wu H, Jin Y, Song J, Gao X. Effect of frozen gloves on chemotherapy-induced neurotoxicity in breast cancer patients: a systematic review and meta-analysis. Front Oncol. 2024;14:1366782. doi: 10.3389/fonc.2024.1366782.
26. Ford K, Duddle M, Turner M, Paterson C. Distal-extremity cryotherapy in preventing chemotherapy-induced peripheral neuropathy from paclitaxel administration in people affected by breast cancer: a systematic review. Semin Oncol Nurs. 2024;40(4):151673. doi: 10.1016/j.soncn.2024.151673.
27. Jia J, Guo Y, Sundar R, Bandla A, Hao Z. Cryotherapy for prevention of taxane-induced peripheral neuropathy: a meta-analysis. Front Oncol. 2021;11:781812. doi: 10.3389/fonc.2021.781812.
28. Rosenbaek F, Holm HS, Hjelmborg JVB, Ewertz M, Jensen JD. Effect of cryotherapy on dose of adjuvant paclitaxel in early-stage breast cancer. Support Care Cancer. 2020;28(8):3763-9. doi: 10.1007/s00520-019-05196-z.
29. Yodchai K, Hubjaroen S, Maneekrong K, Uthaipan N. The efficacy of chemo-cooling gloves in preventing nail toxicity among Thai women undergoing chemotherapy: a quasi-experimental study. Pacific Rim Int J Nurs Res. 2024;28(3):619-31. doi: 10.60099/prijnr.2024.267762.
30. Nilchiagovit T, Lortrakul M, Phisansuthideth U. Development of Thai version of the Hospital Anxiety and Depression Scale in cancer patients. J Psychiatr Assoc Thailand. 1996;41(1):18-30. Available from: https://www.researchgate.net/publication/285837589_Development_of_Thai_version_of_hospital_anxiety_and_depression_scale_in_cancer_patients (in Thai).

31. Chitkumarn P, Rahong T, Achariyapota V. Efficacy of Siriraj, in-house-developed, frozen gloves for cold therapy reduction of chemotherapy-induced peripheral neuropathy in gynecological cancer patients: randomized controlled trial. Support Care Cancer. 2022, 30(6):4835-43. doi: 10.1007/s00520-022-06890-1.
32. Cohen, J. Statistical power analysis for the behavioral sciences. 2nd ed. New Jersey: Lawrence Erlbaum Associates; 1988.
33. Petersen I, Douglas I, Whitaker H. Self controlled case series methods: an alternative to standard epidemiological study designs. BMJ. 2016;354: i4515. doi: 10.1136/bmj.i4515.
34. Postma TJ, Aaronson NK, Heimans JJ, Muller MJ, Hildebrand JG, Delattre JY, et al. The development of an EORTC quality of life questionnaire to assess chemotherapy-induced peripheral neuropathy: the QLQ-CIPN20. Eur J Cancer. 2005;41(8):1135-9. doi: 10.1016/j.ejca.2005.02.012.
35. Prasertsri N, Kaewmanee C, Khantichitr P, Teeyapan W, Smith EML, Wamaloon C, et al. Chemotherapy-induced peripheral neuropathy (CIPN): a cross-sectional study in cancer patients. J Nurs Public Health Educ. 2017;18(3): 52-62. Available from https://he01.tci-thaijo.org/index.php/bcnpy/article/view/106833 (in Thai).
36. Li R, Liu Y, Xue R, Wang Y, Zhao F, Chen L, et al. Effectiveness of nonpharmacologic interventions for chemotherapy-induced peripheral neuropathy in patients with breast cancer: a systematic review and network meta-analysis. Cancer Nurs. 2025;48(2):E98-110. doi: 10.1097/NCC.0000000000001278.
37. Tandon M, Yacur M, Brenin C, Dillon P. Cryotherapy for prevention of chemotherapy induced peripheral neuropathy in breast cancer. Crit Rev Oncol Hematol. 2024;194: 104244. doi: 10.1016/j.critrevonc.2023.104244.
38. Tai HY, Lin LY, Huang TW, Gautama MSN. Efficacy of cryotherapy in the prevention of chemotherapy-induced peripheral neuropathy: a systematic review and meta-analysis. Support Care Cancer. 2024;32(7):482. doi:10.1007/s00520-024-08680-3.
39. Desai N, Arora N, Gupta A. Chemotherapy-induced peripheral neuropathy. JAMA Intern Med. 2022;182(7): 766-67. doi: 10.1001/jamainternmed.2022.1812.
40. Klein I, Lehmann HC. Pathomechanisms of paclitaxel-induced peripheral neuropathy. Toxics. 2021;9(10):229. doi: 10.3390/toxics9100229.
41. Lixian S, Xiaoqian Y, Luyan G, Lizhi Z, Rui D, Hongyue Y, et al. Risk factors of paclitaxel-induced peripheral neuropathy in patients with breast cancer: a prospective cohort study. Front Oncol. 2024;14:1327318. doi: 10.3389/fonc.2024.13273183.

การลดอาการพยาธิสภาพประสาทส่วนปลายเนื่องจากได้รับเคมีบำบัด และการส่งเสริมความพึงพอใจ โดยใช้นวัตกรรมถุงมือเย็นยางพาราในสตรีมะเร็งเต้านม : การศึกษาแบบกึ่งทดลอง

ชลธิชา ทองพร้อม ศมนนันท์ ทัศนีย์สุวรรณ กันตพร ยอดใชย*

บทคัดย่อ: อาการพยาธิสภาพประสาทส่วนปลายเนื่องจากได้รับเคมีบำบัด เป็นประสบการณ์อาการรบกวนที่พบบ่อยในสตรีมะเร็งเต้านมที่ได้รับเคมีบำบัดชนิดแพคลิแทกเซล ดังนั้นการลดอาการดังกล่าวจึงมีความจำเป็น การศึกษากึ่งทดลอง มีวัตถุประสงค์เพื่อทดสอบการใช้นวัตกรรมถุงมือเย็นยางพารา ในการช่วยลดอาการพยาธิสภาพประสาทส่วนปลาย และเพิ่มความพึงพอใจในสตรีมะเร็งเต้านมที่ได้รับเคมีบำบัด กลุ่มตัวอย่างเป็นสตรีมะเร็งเต้านมรายใหม่ ระยะที่ 1 และ 2 จำนวน 29 ราย ได้รับยาเคมีบำบัดสูตร ต็อกโซรูบิซิน (อะดริมัยซิน®) และ ไซโคลฟอสฟาไมด์ จำนวน 4 รอบ ครบถ้วนแล้ว และต่อเนื่องด้วยยาเคมีบำบัดชนิดแพคลิแทกเซล จำนวน 4 รอบ ณ ศูนย์ให้ยาเคมีบำบัดแผนกผู้ป่วยนอก โรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในภาคใต้ ระหว่างเดือนมีนาคม 2565 ถึงเดือนเมษายน 2566 กลุ่มตัวอย่างมีการควบคุมการทดลองด้วยตนเอง โดยมือข้างทดลอง จะได้รับการสวมนวัตกรรมถุงมือเย็นยางพารา เป็นระยะเวลา 90 นาที ระหว่างการได้รับเคมีบำบัดชนิดแพคลิแทกเซล จำนวน 4 รอบ (ก่อนให้ยา 15 นาที ระหว่างให้ยา 60 นาที และหลังให้ยาเคมีบำบัดเสร็จ 15 นาที) ในขณะที่มืออีกข้างจะเป็นข้างควบคุม ไม่ได้รับการสวมนวัตกรรมถุงมือเย็นยางพารา เครื่องมือสำหรับการเก็บรวบรวมข้อมูล แบบบันทึกอาการพยาธิสภาพประสาทส่วนปลาย และแบบประเมินความพึงพอใจ วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา และสถิติ generalized linear mixed model

ผลการศึกษา พบว่า นวัตกรรมถุงมือเย็นยางพารา สามารถช่วยลดอาการพยาธิสภาพปลายประสาทส่วนปลายเนื่องจากเคมีบำบัดได้อย่างมีนัยสำคัญทางสถิติ ในรอบที่ 3 (หลังให้ยาเคมีบำบัดเสร็จทันที) และรอบที่ 4 (หลังให้ยาเคมีบำบัด 14 วัน) และสตรีมะเร็งเต้านมมีระดับความพึงพอใจต่อนวัตกรรมถุงมือเย็นยางพาราในภาพรวมระดับมากที่สุด ดังนั้น พยาบาลสามารถนำนวัตกรรมถุงมือเย็นยางพาราไปใช้ในการลดอาการพยาธิสภาพประสาทส่วนปลายเนื่องจากได้รับเคมีบำบัดชนิดแพคลิแทกเซล อย่างไรก็ตาม ควรมีการศึกษาในขนาดกลุ่มตัวอย่างที่ใหญ่ขึ้น

Pacific Rim Int J Nurs Res 2025; 29(4) 763-776

คำสำคัญ : นวัตกรรมทางการพยาบาล ถุงมือเย็นยางพารา พยาธิสภาพประสาทส่วนปลายเนื่องจากได้รับเคมีบำบัด มะเร็งเต้านม

ชลธิชา ทองพร้อม *พยาบาลวิชาชีพ ศูนย์ให้ยาเคมีบำบัด คณะแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ E-mail: cholticha.t@psu.ac.th*
ติดต่อที่ : ศมนนันท์ ทัศนีย์สุวรรณ* *ผู้ช่วยศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยสงขลานครินทร์ E-mail: samonnun.t@psu.ac.th*
กันตพร ยอดใชย *รองศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยสงขลานครินทร์ E-mail: Kantaporn.y@psu.ac.th*