



Effects of aroma self-foot reflexology on peripheral neuropathy, peripheral skin temperature, anxiety, and depression in gynaecologic cancer patients undergoing chemotherapy: A randomised controlled trial

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ABSTRACT

Purpose: Chemotherapy-induced peripheral neuropathy (CIPN) can interfere with activities of daily living and can negatively affect symptoms. Thus, this study aimed to develop and implement an aroma self-foot reflexology regimen based on Cox's Interaction Model of Client Health Behaviour (IMCHB) as an intervention that can be self-performed at home and at any time. The effects of aroma self-foot reflexology on peripheral neuropathy, peripheral skin temperature, anxiety, and depression were examined in patients with gynaecologic cancer who were undergoing chemotherapy.

Methods: This randomized controlled trial included 32 experimental and 31 control patients with CIPN. Data were collected using self-reported questionnaires (CIPN assessment tool, HADS). In the experimental group, peripheral neuropathy, peripheral skin temperature, anxiety, and depression were measured before and after aroma self-foot reflexology therapy for 6 weeks. The control group was provided with identical aroma self-foot reflexology training 6 weeks later and underwent the intervention at that time.

Results: The intervention resulted in lower levels of symptoms of peripheral neuropathy, less interference with activities ($p < .001$), and higher peripheral skin temperature level ($p < .001$). Anxiety and depression decreased in the experimental group ($p < .001$). The ratio of borderline and definite cases of anxiety and depression did not differ between groups.

Conclusions: An aroma self-foot reflexology intervention can reduce CIPN, anxiety, and depression in gynaecologic cancer patients. Further research is required to assess the effects of differences in the content of the intervention and the effects of various numbers of applications and durations of applications based on each individual patient's condition.

1. Introduction

Due to the toxicity of the administered drugs and the cumulative toxicity from repeated administrations, chemotherapy can exert various adverse effects upon the patient, including peripheral neuropathy (Kumar and Sisodia, 2013). Depending on the drug administered, chemotherapy-induced peripheral neuropathy (CIPN) can manifest with various symptoms. Taxane and platinum drugs are highly associated with the occurrence of peripheral neuropathy (Windebank and Grisold, 2008). Most chemotherapy regimens for treating gynaecologic cancers contain drugs that fall into the taxane and platinum classifications (Berek, 2012). Gynaecologic cancer patients who undergo chemotherapy complain of difficulties in their daily lives due to peripheral neuropathy. CIPN can induce physical symptoms, including the

loss of feeling, numbness, discomfort and sensitivity to cold in the hands and feet along with anxiety and depression (Kim et al., 2015). Thus, this condition interferes with daily activities (Toftthagen et al., 2011). A previous investigation reported that the prevalence of CIPN prevalence was 68.1% in the first month following the initial chemotherapy treatment. CIPN was a chronic ailment in most cases (Seretny et al., 2014). Furthermore, in a recent study, CIPN appeared to interfere with daily activities and negatively affected the quality of life; this was mediated by psychological distress resulting from anxiety and depression (Kim et al., 2015).

Transcutaneous electrical nerve stimulation (Cruccu et al., 2007), kinesiatrics (Zhang et al., 2014), and foot reflexology (Dalal et al., 2014) have been implemented as alternative interventions for peripheral neuropathy caused by chemotherapy and diseases, including

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diabetes. Among these methods, foot reflexology is highly effective, specifically for CIPN (Lee et al., 2012; Kurt and Can, 2018). However, previous studies have reported various effects of reflexology on CIPN. For example, the application of reflexology does not affect the frequency and intensity of CIPN, suggesting that it is merely an effect of improving sensory function (Kurt and Can, 2018). Therefore, more research is required to validate the effect of reflexology on CIPN.

Reflexology regularises the functions of the human organs by promoting blood circulation and lymphokinesis, metabolism (Embong et al., 2015), and physical and mental relaxation, which in turn, reduces anxiety, stress, and pain (Stephenson et al., 2000). Moreover, foot reflexology increases the skin temperature by promoting peripheral blood circulation, which induces psychological relaxation (Hun and Pack, 2010). Moreover, it is effective against depression (Kim et al., 2011). Recently, aromatherapy in combination with foot reflexology may help reduce depression and anxiety and improve physical relaxation (Kim and Kim, 2012).

Aromatherapy uses essential oils extracted from the flowers, leaves, or roots of several natural plants and is relatively safe, non-invasive, and can be easily self-administered (Buckle, 2003). The absorption of oils into the skin by massage is effective in reducing anxiety and depression by muscular and psychological relaxation in cancer patients (WilkinsonLoveWestcombeGamblesBurgessCargillYoung et al., 2007). Moreover, aromatherapy massage is an effective nursing intervention in cases of neuropathic pain (Metin et al., 2017). Several existing studies have combined aromatherapy with reflexology to enhance treatment effectiveness. There is a need for further research to develop these interventions and test their effects upon CIPN.

A focus on positive health behaviour is important in cancer patients who must deal with CIPN, anxiety and depression. Health behaviours are heavily influenced by interactions with healthcare professionals (Cox, 1982). Based on IMCHB, which explains the process of eliciting a person's behaviour change, an aroma foot reflexology, which is a self-administered method for the alleviation of CIPN, anxiety and depression, can be delivered through an interactive process with a nurse.

Therefore, this study aimed to develop and implement an aroma foot reflexology regimen based on Cox's Interaction Model of Client Health Behaviour (IMCHB) (Cox, 1982) as an effective intervention that can be carried out at any time by the patient, in any environment. The objective of this study was to examine the effects of aroma foot reflexology on peripheral neuropathy, peripheral skin temperature, anxiety and depression; and to provide evidence for the application of this nursing intervention. The primary outcome of this study will be an effect on peripheral neuropathy, which is the greatest inconvenience for cancer patients. Based on the objectives of this study, it was hypothesized that, compared to the control group, the experimental group that underwent aroma self-foot reflexology would exhibit: (1) a lower level of peripheral neuropathy symptoms, (2) a lower level of interference with activities due to peripheral neuropathy, (3) a higher peripheral skin temperature, (4) a lower level of anxiety and ratio of borderline and definite cases, and (5) a lower level of depression and ratio of borderline and definite cases.

2. Methods

2.1. Study design

This was a randomised controlled study with a pre- and post-test design to verify the effects of aroma self-foot reflexology on peripheral neuropathy, peripheral skin temperature, anxiety and depression in gynaecologic cancer patients undergoing chemotherapy.

2.2. Participants

The subjects of this research were gynaecologic cancer patients receiving chemotherapy and hospitalised in the gynaecological ward of a

tertiary comprehensive hospital in Korea who expressed a desire participate after checking the ward bulletin board and advertisement notices; only those who met the inclusion and exclusion criteria were selected as participants.

2.2.1. Inclusion criteria

- Individuals who received short-term chemotherapy which included drugs in the taxane or platinum group.
 - Individuals with at least two weeks of chemotherapy remaining in the treatment plan.
 - Individuals taking medication for CIPN control (including gabapentin, duloxetine, and pregabalin).
 - Individuals who were able to perform self-care for personal hygiene management.
- Exclusion criteria
- Individuals with a diagnosis of cancer other than gynaecologic cancer.
 - Individuals with pre-existing peripheral neuropathy due to diabetes or other illnesses before chemotherapy.
 - Individuals with a history of diseases related to changes in the peripheral skin temperature (including Raynaud disease).

The sample size was calculated using the G-Power 3.1.9 program (Faul et al., 2009) based on the effect size of 1.02 in a previous study that examined the effectiveness of foot reflexology on peripheral neuropathy in cancer patients receiving chemotherapy (Lee et al., 2012). For an independent *t*-test between the two groups, the minimum sample size was calculated as 27 each for the experimental group and the control group for an effect size of 1.00, significance level of 0.05, and power of .95.

For the random assignment into the experimental group or control group, a research assistant unrelated to this investigation conducted a simple random assignment procedure using a random assignment program, and assigned 33 subjects to the experimental group and 33 to the control group. The assignments were placed in the ward using Sequential Numbered Opaque Sealed Envelopes (SNOSE) to prevent disclosure of the assignment order.

Seventy-seven respondents showed a desire to participate in the study. Among those, 11 respondents were excluded in the screening stage as 8 respondents were not taking medication for peripheral neuropathy, 2 had a history of peripheral neuropathy due to diabetes, and 1 had a previous experience with foot reflexology. Among the remaining 66 subjects randomly assigned to a group, one experimental group subject was excluded because of a change in the treatment plan due to worsening of the disease during the study, and two control group subjects were excluded as they withdrew their consent. Therefore, data from 32 subjects in the experimental group and 31 subjects in the control group were used in the final analysis (Fig. 1).

2.3. Ethical considerations

Approval from the Institutional Bioethics Review Board of the hospital in which the study was to be conducted was granted prior to the beginning of the study. Subject recruitment was conducted via voluntary participation in response to notices posted within the ward. Those willing to participate were provided detailed explanations about the purpose, methods, and processes of the study by the researcher, and written consent was obtained. Subjects were informed they could immediately terminate their participation at any point during the investigation. Any data from participants who desired termination of participation were excluded from the analysis.

2.4. Study tools

This study used a self-reporting survey, structured to measure the

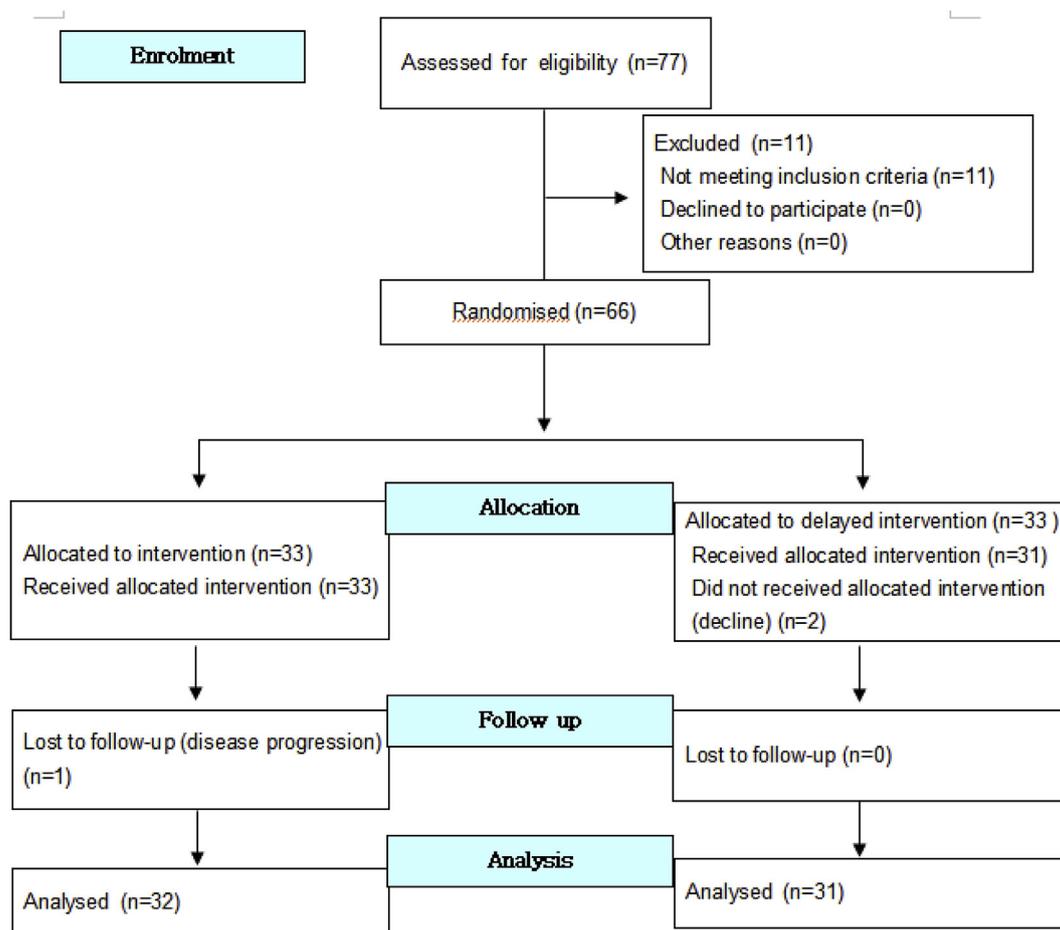


Fig. 1. Flow diagram of the study.

symptoms of peripheral neuropathy and the resulting interference with daily activities, anxiety, and depression. Peripheral skin temperature, which is a biological measurement, was measured at the centre of the plantar surfaces of both feet. Twelve items regarding general and treatment-related characteristics were measured before the start of the aroma foot reflexology therapy. Symptoms of peripheral neuropathy, interference with activities, anxiety, and depression were measured before and after the therapy. The survey, constructed to measure the symptoms and interference with activities, was used after receiving approval from the developers of the tool. The Hospital Anxiety-Depression scale (HADS) was used after registering for GL (Granada Learning) assessment and purchasing the tool on the website (<http://www.gl-assessment.co.uk/>), following the published procedures.

2.4.1. Symptoms of peripheral neuropathy and interference with activities

Symptoms of peripheral neuropathy and the resulting interference with daily activities were measured using the “Symptom and interference with activities due to peripheral neuropathy” measurement section of the CIPN assessment tool developed by Tofthagen et al. (2011). The peripheral neuropathy symptom tool is constructed to rate nine items that measure loss of feeling and numbness in the hands and feet, sensitivity to coldness, discomfort, tingling in the muscles or joints, sense of weakening in the arms or legs, and difficulty in balancing on a 0–10 point line. A higher score indicates significant peripheral neuropathy symptoms. Cronbach's α was 0.93 at the time of tool development and .88 in our study.

The tool for interference with activities is constructed to rate 14 daily activities, including putting on clothes, walking, lifting objects, holding objects, driving, and work duties, on a 0–10 point line based on the level of disability. A higher score indicates a higher level of

interference with daily activities. Cronbach's α was 0.90 at the time of tool development and .85 in our study.

2.4.2. Peripheral skin temperature

Peripheral skin temperature refers to the temperature measured on the skin at the centre of the plantar surfaces of both feet using the hand-held digital skin thermometer (model number: Testo 830-T1, TESTO, Germany). To reduce errors caused by the equipment, the same skin thermometer was used to measure the temperature before and after the therapy for all subjects. The temperature was measured at least 1 h after a meal in the hospital, and the environment was controlled with a central control system, which maintained room temperature at 23–25 °C and humidity under 60%. Additionally, subjects were asked to relax in bed for 30 min with their socks on; the temperature of each foot was then measured twice at a point 5 cm away from the centre of the plantar surfaces of each foot immediately after removing the socks. The average of a total of four measurements (two for each foot) was used for the analysis.

2.4.3. Anxiety and depression

Anxiety and depression were measured using HADS developed by Zigmond and Snaith (1983). The tool comprises 14 items—seven odd items measuring anxiety and seven even items measuring depression. Each item comprises a 4-point scale from 0 to 3. Anxiety and depression scores both range between 0 and 21, with a higher score indicating a higher level of anxiety and depression. Cronbach's α for anxiety and depression were .89 and .86, respectively, at the time of tool development, and 0.88 and 0.89, respectively, in this study. The cut-off line for anxiety and depression suggested by the tool is 7 points each. A score of 0–7 indicates normal range; a score of 8–10, ‘borderline cases’ needing

further psychiatric assessment before a definitive diagnosis is established, and a score of 11–21 indicates the probable presence of a mood disorder.

2.5. Experimental treatment: aroma self-foot reflexology

The general structure of the experimental treatment training and intervention procedure was theoretically based on the IMCHB developed by Cox (1982). The aroma oil used for the foot reflexology was selected based on expert advice and a smell test performed by a professional from the Certification Academy for Holistic Aromatherapy with at least 15 years of experience as a lecturer in aromatherapy education. The effects of the selected oil were also assessed by reviewing previous studies (Buckle, 2003; Hong et al., 2008). The selected aroma oils were argan carrier oil and mandarin, black pepper, pine, and tea tree essential oils. The essential oils were diluted to 3% concentration with 20 ml of argan oil. Four types of essential oils were blended in equal proportion (1:1:1:1). The dose of each oil was 5 drops (0.25 ml) per foot for each session.

Based on methods used in previous studies (Kim et al., 2011; Lee et al., 2012) and those suggested by the Association of Korean and Chinese Natural Healing Abilities, self-foot reflexology procedures were made into a protocol and produced in a booklet form (Fig. 2). The contents of the educational material were revised based on expert advice from a foot reflexology professional with more than 20 years of experience in foot reflexology education and a researcher with many publications in the field of foot reflexology. This protocol was tested on subjects during a pilot study before use in the present study. The confirmed steps for applying aroma foot reflexology were tested for validity using expert opinion. The validity was confirmed by an expert group comprising five gynaecology specialists at the hospital in which the study was to be conducted, two chief nurses in the gynaecology ward, and one specialised gynaecologic oncology nurse.

The contents of the self-performed aroma foot reflexology educational material were structured based on the elements of the client-professional interaction of the IMCHB developed by Cox (1982). For training, the researcher provided the booklet and 60 min of independent training during dinner time before starting intravenous injection the day before chemotherapy. A separate area in the ward was used for training to prevent contact with other patients in the same ward. After training, the experimental treatment (self-massage method) was performed by the subjects at home after discharge. Subjects were asked to perform the massage three times a week, for 30 min per session (15 min for each foot). To promote the continuation of intervention, the researcher conducted biweekly phone monitoring. Additionally, the subjects were asked to record each aroma foot reflexology session to confirm correct performance. The experimental treatment was set at 18 sessions over a period of 6 weeks based on a systematic review of aroma massage (Lee et al., 2012), which found the therapy to be effective

when performed at least 12 times in 6 weeks.

Each session of aroma self-foot reflexology comprised a ready phase, relaxation massage phase, stimulation of reflex zone phase, and a rest phase. In the relaxation massage phase, massage was applied using the hands. In the stimulation of reflex zone phase, a reflex rod was used to effectively stimulate the reflex zone. To increase the effect on the research variables, the basic reflex zone, direct reflex zone, and indirect reflex zone were all included in the stimulation of reflex zone phase. The details of the experimental procedure based on the IMCHB are shown in Table 1.

2.6. Procedure and data collection

2.6.1. Researcher qualifications

Before conducting this study, the researcher obtained certification, qualifying them as an aroma therapist through The Certification Academy for Holistic Aromatherapy. Additionally, certification was received from the Association of Korean and Chinese Natural Healing Abilities after completing the training for foot reflexology.

2.6.2. Pilot study and training for the research assistants

Before conducting this study, a pilot study was conducted to test the applicability of the experimental treatment and the appropriateness of the survey. The pilot study was conducted for one month on three subjects to identify revisions that would need to be made in the experimental treatment. Two research assistants, who took part in this study, provided assistance with survey completion and checked for omitted answers. They also measured the peripheral skin temperature at the bottom of both feet before and after therapy.

2.6.3. Study procedure

The data collection for this study was started following the completion of the pilot study. The study was conducted over 4 months between June 18, 2016 and October 18, 2016 until the completion of the after-intervention investigation.

Study subjects were randomly allocated to experimental or control groups. The researcher provided the experimental cohort with training for the treatment immediately after the allocation and aroma self-foot reflexology was performed for 6 weeks. For the control group, the same experimental treatment was performed six weeks after the allocation and not before then. Subjects willing to voluntarily participate in the study were screened on the day of hospitalisation—one day before chemotherapy based on inclusion and exclusion criteria. After the subjects were selected, the researcher explained the study procedure and obtained written consent after which, random allocation was performed by an assistant, unrelated to the study, using cards.

For the experimental group, the researcher, who was a provider of the intervention, provided education regarding the experimental treatment after pre-intervention investigation. Subjects were allowed to

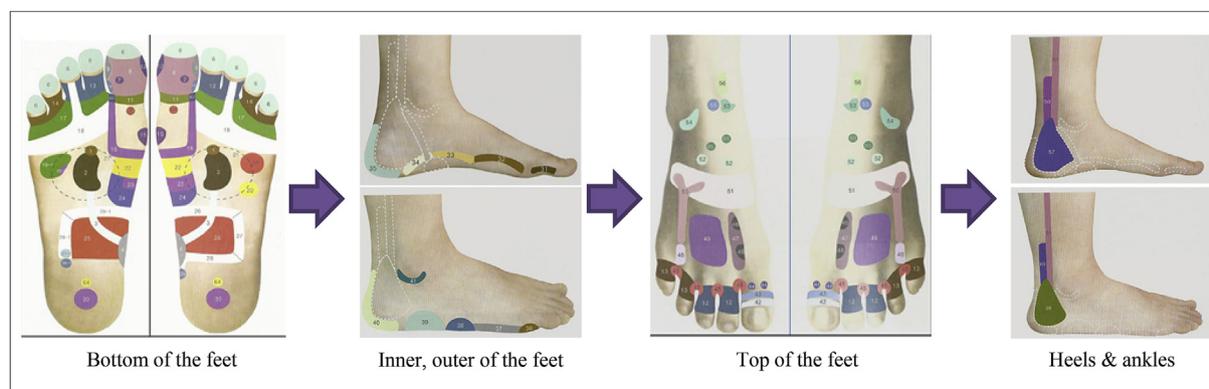


Fig. 2. Areas where reflexology of the study.

Table 1
Procedure of the aroma self-reflexology.

Phase	Detailed Contents	139. IMCHB 140. Factor	Consumed Time (minutes)
Training for experimental treatment	<ul style="list-style-type: none"> - Defining chemotherapy-induced peripheral neuropathy - Symptoms and progression of peripheral neuropathy - Lifestyle caution related to peripheral neuropathy - Training in aroma oil - Training and demonstration of aroma self-foot reflexology methods ✓ Ready phase <ul style="list-style-type: none"> ● Perform at least 1 h after eating dinner ● Wash feet below the knees using warm water ✓ Relaxation massage phase (repeat a motion three times) <ul style="list-style-type: none"> ● Perform massage in the order of left foot → right foot ● Massage at medium intensity without pain (perform after spreading oil) ● Ten types of relaxation massage motions beginning from the bottom to the top of the feet ✓ Stimulation of reflex zone phase (repeat a motion three times) <ul style="list-style-type: none"> ● Basic reflex zone ● Bottom of the foot (17 reflex zones) → Inner foot → Outer foot → Top of the foot (8 zones) → Heel of the foot, ankle ● Basic reflex zone ✓ Rest phase <ul style="list-style-type: none"> ● Conclude by straightening both legs and slightly clapping the two feet together ● Wear cotton socks to prevent slipping and maintain warmth ● Drink 200 cc of warm water within 30 min of completion - Wrap-up ● Confirmation of understanding training ● Question and answer 	Health information 141. Professional/142. technical competencies	143.60 min
Performance of experimental treatment	Aroma self-foot reflexology performance and record of performance Aroma self-foot reflexology performance phone monitoring	Decisional control	Three 30-min sessions per week for 6 weeks Two times per week

perform aroma self-foot reflexology at home three times per week for 6 months and were monitored via biweekly phone calls. In contrast, subjects in the control group were told that the experimental treatment would be conducted in 6 months, at the time of hospitalisation for a follow-up chemotherapy. The control group was provided aroma self-foot reflexology training, similar to the one provided to the experimental group, 6 weeks later and underwent the intervention at that time point. Subjects in both the experimental group and the control group received the aroma self-foot reflexology intervention, and each patient had the perception that he or she was participating in the experimental group.

2.7. Statistical analysis

SPSS version 22.0 program was used to conduct data analysis. The characteristics of the experimental and control groups were analysed using descriptive statistics. A pre-intervention test of homogeneity was analysed using the independent *t*-test, Chi-square test, and Fisher's exact test.

The pre-intervention test of homogeneity for experimental variables between the experimental group and the control group was analysed using the independent *t*-test. To examine the effect on the experimental variables in the experimental and control groups, the differences in pre- and post-intervention levels of; peripheral neuropathy symptoms, interference with activities, peripheral skin temperature, anxiety, and depression levels were analysed using the independent *t*-test. The effects on the ratio of borderline and definite cases of anxiety, and depression were analysed using Chi-square test.

3. Results

There was no harm or unanticipated risk associated with the study intervention.

3.1. General and treatment-related characteristics of subjects

Examination of the general characteristics of subjects, including; age, marital status, religion, education level, cohabitating family, and family monthly income showed no significant differences between the experimental and control groups across all items; thus, the homogeneity of the subjects was established (Table 2).

3.2. Study variables

Table 3 demonstrates the results of the pre-intervention test of homogeneity on study variables, namely, symptoms of peripheral neuropathy, interference with activities, peripheral skin temperature on the bottom of the feet, anxiety and depression. There were no significant differences between the experimental group and the control group across all items; thus, the homogeneity of the subjects was established.

3.3. Effect on peripheral neuropathy symptoms

The peripheral neuropathy symptoms in the experimental group that underwent aroma self-foot reflexology were reduced by 0.35 ± 0.56 points on average after the intervention, whereas the symptoms in the control group increased by 0.30 ± 0.40 points on average; the difference was statistically significant ($t = 5.26$, $p < .001$). Thus, Hypothesis 1 was supported (Table 4).

3.4. Effect on interference with activities

The interference with activities scores from the experimental group, obtained after undergoing the intervention, decreased by 0.25 ± 0.26 points on average, relative to pre-intervention scores, whereas that of the control group increased by 0.09 ± 0.25 points on average; thus, there was a statistically significant difference ($t = 5.42$, $p < .001$).

Table 2
Homogeneity of general and therapeutic characteristics of participants before intervention (n = 63).

Characteristics		Categories	Exp.(n = 32) n (%) or M ± SD	Con.(n = 31) n (%) or M ± SD	t or χ^2	p
General characteristics	Age (yr)		56.34 ± 9.04	55.36 ± 9.96	0.41	.681 ^a
	Spouse	Yes	23 (71.9)	26 (83.9)	1.32	.252 ^b
		No	9 (28.1)	5 (16.1)		
	Religion	Yes	20 (62.5)	23 (74.2)	0.99	.319 ^b
		No	12 (37.5)	8 (25.8)		
	Educational level	≤ Middle school	14 (43.8)	7 (22.5)	3.96	.138 ^b
		High school	8 (25.0)	14 (45.2)		
		≥ College	10 (31.2)	10 (32.3)		
	Number of family members	≤ 2	16 (50.0)	13 (41.9)	0.41	.521 ^b
		≥ 3	16 (50.0)	18 (58.1)		
Monthly income (million won)	< 2	11 (34.4)	6 (19.4)	2.85	.415 ^b	
	2 to < 3	9 (28.1)	13 (41.9)			
	3 to < 4	5 (15.6)	7 (22.6)			
	≥ 4	7 (21.9)	5 (16.1)			
Therapeutic characteristics	Diagnosis	Ovarian cancer	25 (78.1)	25 (80.6)	0.27	.938 ^c
		Cervical cancer	4 (12.5)	3 (9.7)		
		Endometrial cancer	3 (9.4)	3 (9.7)		
	Recurrence	Yes	12 (37.5)	12 (38.7)	0.01	.921 ^b
		No	20 (62.5)	19 (61.3)		
	Number of total chemotherapy sessions		5.63 ± 3.94	5.42 ± 3.03	0.23	.818 ^a
		Chemotherapy protocol	Taxane + platinum	27 (84.4)	26 (83.9)	0.01
		Doxil (Caelyx) + Platinum	5 (15.6)	5 (16.1)		
	Drug for neuroprotection (daily)	Gabapentin 300 mg	3 (9.4)	5 (16.1)	1.36	.751 ^c
		Gabapentin 900 mg	25 (78.0)	22 (71.0)		
		Duloxetine 60 mg	2 (6.3)	3 (9.7)		
		Pregabalin 150 mg	2 (6.3)	1 (3.2)		

^a t-test.

^b Chi-square test.

^c Fisher's exact test.

Hypothesis 2 was, therefore, supported (Table 4).

3.5. Effect on peripheral skin temperature

The peripheral skin temperature at the bottom of both feet in the experimental group increased by $1.09 \pm 1.11^\circ$ on average following intervention, whereas that of the control group decreased by $0.45 \pm 1.62^\circ$ on average. There was, therefore, a statistically significant difference ($t = -4.41$, $p < .001$), thus, Hypothesis 3 was supported (Table 4).

3.6. Effect on anxiety

The anxiety score in the experimental group decreased by 1.56 ± 1.46 points on average after intervention, while that of the control group increased by 0.90 ± 1.01 points on average, which represented a statistically significant difference ($t = 7.82$, $p < .001$). The ratio of borderline and definite cases of anxiety was lower in the experimental group (21.9%) than in the control group (13.9%); however, there was no significant difference ($\chi^2 = 2.92$, $p = .087$). Hypothesis 4 was, therefore, partially supported (Table 4).

3.7. Effect on depression

The depression score in the experimental group decreased by

1.28 ± 1.02 points on average after intervention, whereas that of the control group increased by 0.90 ± 1.07 points on average. There was, therefore, a statistically significant difference ($t = 8.26$, $p < .001$). The ratio of borderline and definite cases of depression was lower in the experimental group (21.9%) than in the control group (13.9%), but there was no significant difference ($\chi^2 = 0.45$, $p = .503$). Thus, Hypothesis 5 was partially supported (Table 4).

4. Discussion

In this study, the effects of aroma self-foot reflexology on CIPN symptoms, peripheral skin temperature, anxiety, and depression in gynaecologic cancer patients undergoing chemotherapy were evaluated. It was observed that aroma self-foot reflexology caused significant reductions in the scores of peripheral neuropathy symptoms, interference with activities, anxiety, and depression, and a significant increase in the peripheral skin temperature.

Following the administration of aroma self-foot reflexology, there was a statistically significant reduction in peripheral neuropathy symptoms and interference with activities. These results are in line with those from a study by Lee et al. (2012), which reported the use of foot reflexology in cancer patients with continued CIPN; similar to this study, they observed that the therapy caused a reduction in peripheral neuropathy and distressing symptoms. The results of this study are similar to those of a previous study on the effectiveness of foot

Table 3
Homogeneity of study variables before intervention (n = 63).

Variable	Range	Exp.(n = 32) M ± SD	Con. (n = 31) M ± SD	t	p
Peripheral neuropathy symptom	0–10	3.19 ± 1.35	2.82 ± 1.69	0.96	.340
Interference with activities	0–10	1.89 ± 0.94	1.54 ± 1.01	1.40	.166
Peripheral skin temperature on the sole		33.37 ± 1.01	33.18 ± 1.16	0.68	.499
Anxiety	0–21	7.25 ± 4.05	6.48 ± 3.06	0.84	.402
Depression	0–21	9.31 ± 4.47	8.58 ± 4.36	0.66	.513

Table 4
Tests of hypotheses (n = 63).

Variable	Categories	Exp. (n = 32) M ± SD or n (%)	Con. (n = 31) M ± SD or n (%)	t or χ^2	p
Peripheral neuropathy symptom	Post-test	2.84 ± 1.47	3.12 ± 1.50	5.26	< .001
	Difference	0.35 ± 0.56	-0.30 ± 0.40		
Interference with activities	Post-test	1.63 ± 0.86	1.63 ± 0.94	5.42	< .001
	Difference	0.25 ± 0.26	-0.09 ± 0.25		
Peripheral skin temperature on the sole	Post-test	34.49 ± 0.83	32.76 ± 1.41	-4.41	< .001
	Difference	-1.09 ± 1.11	0.45 ± 1.62		
Anxiety	Post-test	5.69 ± 3.46	7.39 ± 3.23	7.82	< .001
	Difference	1.56 ± 1.46	-0.90 ± 1.01		
	Normal (0–7)	25 (78.1)	18 (58.1)		
	borderline and definite cases (> 7)	7 (21.9)	13 (41.9)		
Depression	Post-test	8.03 ± 4.28	9.48 ± 4.14	8.26	< .001
	Difference	1.28 ± 1.02	-0.90 ± 1.07		
	Normal	14 (43.7)	11 (35.5)		
	borderline and definite cases (> 7)	18 (56.3)	20 (64.5)		

reflexology in pain reduction in terminal cancer patients (Stephenson et al., 2007). The effectiveness of aroma foot reflexology on peripheral neuropathy may be due to the fact that large nerve fibres are stimulated, the perception of pain is suppressed, excitation of the sympathetic nervous system is controlled and the process of massaging the reflex zones in the feet balances the nervous system (Mackey, 2001), which leads to relaxation. Furthermore, the main chemical ingredient in the black pepper oil used in this study is caryophyllene with sesquiterpenes, which has relaxing and pain reducing effects (Hong et al., 2008). Furthermore, bornyl acetate is the main ingredient of pine; it contains esters, which helps with contraction and relaxation (Buckle, 2003), and probably contributes to its effectiveness in treating peripheral neuropathy. Although statistical significance was found in the case of effect on interference with activities, the changes in the experimental and control groups were not large. The results may be attributed to the low scores (< 2 points) of the pre-intervention measurements of interference with activities in both the experimental and the control groups. Therefore, clinical significance can be suggested more clearly if aroma foot reflexology is applied and its effects tested after controlling for a certain level of interference with activities during the preliminary subject selection process in the future.

With regards to the effect of aroma self-foot reflexology on peripheral skin temperature, post-intervention temperatures in the bottom of both feet in the experimental group increased significantly in comparison to the control group. This is in line with the results of previous studies on middle-aged women (Hun and Pack, 2010), elderly women (Kim et al., 2011), and female college students (Lee, 2011), where a significant increase in foot temperature was observed after foot reflexology.

These results reconfirm that foot reflexology improves peripheral blood circulation and ultimately increases the peripheral skin temperature (Mackey, 2001). Furthermore, the black pepper oil used in this study has a warming characteristic; it is known to improve blood circulation and is effective against circulatory disturbances (Hong et al., 2008), and these properties may have contributed to the increase in the foot temperature. Moreover, instructions for care related to peripheral neuropathy were included in the experimental treatment training, which included instructions about always wearing cotton socks. Following these lifestyle changes may have had a positive impact on the maintenance of foot temperature.

With regards to the effects of aroma self-foot reflexology on anxiety and depression, there was no significant difference in the ratio of borderline and definite cases. Despite this, HADS score reductions in the experimental group compared to the control group, indicated that this therapy had a positive effect upon gynaecologic cancer patients with comparatively high levels of anxiety and depression. It should be noted, however, that previous studies related to the effects of foot reflexology on anxiety and depression all used different measurement tools, thus,

the results are conflicting and comparing these investigations to our study is therefore difficult. Foot reflexology was an effective intervention for anxiety reduction in a previous study on terminal cancer patients (Stephenson et al., 2007) and ovarian cancer patients undergoing chemotherapy (Hwang et al., 2005), results similar to ours.

In contrast, the effect of foot reflexology on anxiety and depression in a previous study on cancer patients who received chemotherapy was not significant (Lee et al., 2012). Using the same measuring tools as those used in this study, Sharp et al. (2010) studied the effects of foot reflexology and massage in women undergoing cancer surgeries and compared them to a control group; the results showed that no significant difference between both groups with regard to severe anxiety and depression, indicating that both foot reflexology and massage did not significantly reduce severe anxiety and depression.

The reduction of anxiety and depression following foot reflexology in this study may have been due to improved blood circulation through stimulation of reflex zones containing trigger points for organs, including the kidneys, adrenal glands, and liver, along with physical relaxation and emotional purification (Embong et al., 2015). A previous study that did not find foot reflexology to be effective for anxiety and depression (Lee et al., 2012) suggested an expansion of the reflex zones used for massage to increase the effect on anxiety and depression. In this study, consideration was given to this issue such that the scope of the reflex zone was not limited to the bottom of the feet, but also included the inner, outer, and top of the feet, heels, and ankles, which may have worked effectively. Moreover, among the essential oils used in this research, mandarin, which is extracted from the peels of citrus fruits, was used. Along with its fragrance, mandarin also has mood elevating effects (Hong et al., 2008), and therefore, may have contributed to the reduction in anxiety and depression.

Despite this, there was no significant difference between both groups with regard to mild to severe anxiety and depression, thus demonstrating the need for the continuous application of the intervention. The reason for inconsistent reports of the effect of foot reflexology on anxiety and depression and incomplete alleviation of depression may be due to the patient having to go through the long-term complex treatments, and dealing with the side effects and the diagnosis. Therefore, when developing an intervention to solve psychological problems like anxiety and depression in cancer patients, continuous implementation is more useful than a short-term program (Oh and Choi, 2012). In that regard, the self-conducted treatment used in this study can have long-term effects as it can be used without time constraints.

With regards to the experimental treatment protocol, the process of blending of mandarin, black pepper, pine, and tea tree essential oils used in the aroma foot reflexology in this study was different from that used in previous studies to control symptoms, including pain, sleep, and constipation. Additionally, blending four oils that have independent effects may have had a synergistic effect (Hongratanaworakit, 2011) on

the improvement of peripheral neuropathy, anxiety, and depression and peripheral skin temperature. Therefore, we suggest that the regimen of blending of oils, as used in this study, is an appropriate regimen for controlling chemotherapy-induced symptoms, including peripheral neuropathy, anxiety, and depression.

The aroma self-foot reflexology intervention conducted in this study was provided based on the “elements of client-professional interaction” section of the IMCHB described by Cox (1982). Therefore, there was an alleviation of symptoms with respect to all elements (peripheral neuropathy, peripheral skin temperature, anxiety, and depression) indicating that aroma self-foot reflexology intervention caused a positive health behaviour change (Cox, 1982) in patients with chemotherapy-induced changes, including peripheral neuropathy, anxiety, and depression.

One of the criteria for subject selection and testing for pre-intervention neuropathy in this study was that patients had to be taking medication for peripheral neuropathy. The dosage or frequency of medication for peripheral neuropathy was not controlled after the subject's participation. Better documentation of the medications taken can increase the validity of the results in future studies. Furthermore, outcomes, including a reduction in medications used, can be selected to denote the intervention effectiveness. Despite these limitations and considerations, the procedures and results of this study are significant in that they demonstrated the validity of using an aroma self-foot reflexology intervention, which can be practically and continuously used in hospitals and at home for cancer patients who experience various health problems due to chemotherapy.

In this study, it was determined that aroma self-foot reflexology was an effective approach in improving gynaecologic cancer patients' CIPN, anxiety, and depression in the experimental group. No significant difference was found between the two groups regarding its effectiveness in the ratio of borderline and definite cases on anxiety, and depression.

Based on the aforementioned results and discussion, the following are suggested. First, a replication study that assesses the effects of applying aroma self-foot reflexology using varied detailed contents and various number of and durations of applications based on the individual condition of each cancer patient should be carried out. Moreover, we suggest developing and assessing the effects of interventions and training programs for the management of physical and psychological symptoms of cancer patients from a different perspective using the experimental treatment development process suggested in this study. Finally, a longitudinal study may assess the long-term effects of the application of aroma self-foot reflexology on symptom relief in cancer patients.

Conflict of interest

The authors declare that they have no competing interests.

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