



Derleme

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THE EFFECTIVENESS OF WARM-WATER FOOTBATH ON PAIN MANAGEMENT OF PATIENTS AT  
HEALTHCARE SETTINGS: A SYSTEMATIC REVIEW  
SAĞLIK BAKIMI ORTAMLARINDAKİ HASTALARIN AĞRI KONTROLÜNDE SICAK SU AYAK  
BANYOSUNUN ETKİSİ: SİSTEMATİK DERLEME

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This review aimed to systematically assess the available evidence on the effectiveness of warm-water footbath on pain management of patients treated in various healthcare settings. In the present systematic review, five databases (Cochrane, Scopus, CINAHL, Pub Med and Web of Science) were searched for randomized controlled trials and quasi-experimental studies based on the keywords ("foot bath" OR "footbath" OR "foot bathing") AND (pain) AND ("warm water" OR "warm water" OR "hot water") between 2015-2020 years. The Joanna Briggs Institute Critical Appraisal checklists (for randomized controlled trials and quasi-experimental studies) were used to evaluate the risk of bias and quality assessment. Within the initial advanced search of databases, 651 articles were obtained with 11 full-text articles meeting the eligibility criteria. After completing the quality assessment, three studies were included in this systematic review. Results demonstrated that the positive effect of warm-water footbath is limited to patients who have osteoarthritis joint pain. Due to the limited number of studies on this intervention and methodical limitations of the included studies, the effectiveness of warm-water footbath intervention on pain management of patients from healthcare settings is unclear. Methodologically well-designed studies remain necessary in this area (Prospero Registration Number: CRD42023449216).

**ÖZ**

Bu derlemenin amacı, çeşitli sağlık bakımı ortamlarında tedavi gören hastaların ağrılarının kontrolünde sıcak su ayak banyosunun etkinliğine ilişkin mevcut kanıtları sistematik olarak değerlendirmektir. Mevcut sistematik derlemede, ("foot bath" veya "foot bath" veya "foot bathing") ve (pain) ve ("warm water" veya "warm-water" veya "hot water") anahtar kelimeleri kullanılarak 2015-2020 yılları arası beş farklı veri tabanındaki (Cochrane, Scopus, CINAHL, Pub Med and Web of Science) randomize kontrollü ve yarı deneysel çalışmalar tarandı. Yanlılık riskini ve kalitesini değerlendirmek için Joanna Briggs Enstitüsü Kritik Değerlendirme kontrol listeleri (randomize kontrollü ve yarı deneysel çalışmalar için) kullanıldı. Veritabanlarının ilk gelişmiş taramasında 651 makaleye ve derlemenin uygunluk kriterlerini karşılayan 11 tam metin makaleye ulaşıldı. Yazarlar tarafından tamamlanan kalite değerlendirmesinin ardından sistematik incelemeye üç çalışma dahil edildi. Bulgular, sıcak su ayak banyosunun olumlu etkisinin osteoartrit eklem ağrısı olan hastaların ağrı yönetimi ile sınırlı olduğunu gösterdi. Bu girişime ilişkin çalışmaların sınırlı sayıda olması ve dahil edilen çalışmaların metodolojik kısıtlamaları nedeniyle, sıcak su ayak banyosunun sağlık bakımı ortamlarında tedavi gören hastaların ağrı kontrolündeki etkinliği net değildir. Bu alanda metodolojik olarak iyi tasarlanmış çalışmalara gereksinim duyulmaktadır (Prospero Kayıt Numarası: CRD42023449216).

**Keywords:** Footbath, pain management, systematic review, warm water

**Anahtar kelimeler:** Ayak banyosu, ağrı yönetimi, sistematik derleme, sıcak su

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## INTRODUCTION

Pain is terminologically defined as an unpleasant sensory or emotional experience associated with tissue damage.<sup>1</sup> Although it is a multidimensional and complex sensation, it is perceived in the brain as a result of the interaction between the peripheral and central nervous system through the nociception process.<sup>2,3</sup> According to the Gate Control Theory, one of the well-known pain theories, stimulation of the skin activates large diameter fibers, suppresses small diameter fibers carrying the pain message and closes the door to the passage of stimuli felt as pain. This theory guided future studies to examine the effectiveness of peripherally effective interventions (such as massage, applying hot or cold water) on pain management.<sup>4,5</sup> In their study, Kiy et al.<sup>6</sup> reported that applying cold therapy for 15 minutes before deep breathing and coughing exercises was effective in relieving pain in patients with chest tubes. A comprehensive meta-analysis showed that massage therapy can alleviate postoperative pain in both short and long terms.<sup>7</sup> The results of these studies show that skin stimulation techniques are effective in controlling pain by themselves.<sup>8,9</sup> Another example of these skin stimulation techniques is warm-water foot bathing.<sup>10,11</sup> The warm-water foot bathing intervention involves submerging the feet in warm water for a predetermined amount of time.<sup>11,12</sup> The water temperature and footbath length in studies on footbath intervention range from 37 to 43°C and 10 to 30 minutes, respectively.<sup>13-15</sup> According to studies, the warm water used for foot baths stimulates touch receptors, activates the parasympathetic nervous system, and the gate control mechanism. Moreover, it increases blood flow and oxygen supply with vasodilatation, eliminates metabolic wastes and reduces the molecules that activate nociceptors (such as noradrenaline).<sup>12,16,17</sup> These outcomes prove the efficacy of warm-water foot bathing on pain relief. Subsequently, many studies have been carried out on this subject and already have shown to treat pain after surgery,<sup>18</sup> joint pain in osteoarthritis,<sup>19,20</sup> and labor pain.<sup>11</sup> It has been used also as a complementary therapeutic intervention in diabetic foot ulcers<sup>21</sup> and peripheral neuropathy.<sup>22,23</sup>

At the healthcare settings, adequate pain management is essential to increase patient satisfaction rates and improve the quality of care. Studies report that, patients

who suffer pain are physically limited, experience low life quality, increase the costs for healthcare settings and lower the care quality.<sup>24-26</sup> Although warm-water foot bathing has been widely used in several studies to evaluate its effect on pain management, there is no comprehensive systematic review to explore the effectiveness of this intervention on pain management in patients from healthcare settings. Therefore, this systematic review aims to systematically and critically assess the available evidence on the effectiveness of warm-water footbath on pain management of patients from various healthcare settings. Given that systematic reviews are at the top of the evidence hierarchy and establish connections between theory and evidence, it is expected that the information obtained from the present systematic review will provide implications for practice and suggest important directions for future research.

## MATERIAL AND METHODS

### Protocol and design

The protocol of this systematic review was registered in the International Prospective Register of Systematic Reviews (Registration ID number: CRD42023449216), which is available at [https://www.crd.york.ac.uk/Prospero/display\\_record.php?RecordID=449216](https://www.crd.york.ac.uk/Prospero/display_record.php?RecordID=449216). The study was designed as a systematic review and developed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>27</sup>

### Search strategy

The searches were conducted independently by two authors using the following five databases: Cochrane, Scopus, CINAHL, Pub Med and Web of Science in September 2022. The search strategy was based on the keywords ("foot bath" OR "footbath" OR "foot bathing") AND (pain) AND ("warm water" OR "warm-water" OR "hot water").

### Eligibility criteria

The inclusion and exclusion criteria applied are listed based on PICOS process (Table 1). The publication date was not limited and extended to the beginning of the databases.

### Study selection

All the search results were imported into Microsoft® Office Excel according to their article titles. After sorting them by their titles, all duplicates were found and

**Table 1.** Inclusion and exclusion criteria based on PICOS

PICOS	Inclusion criteria	Exclusion criteria
Patient	Patients treated in healthcare settings Adult patients (>18 years)	Pediatric patients Emergency patients Dental patients Animal studies
Intervention	Footbath with warm water	Footbath with salt warm water Footbath with cold water Footbath mixed with massage Footbath with aromatherapy Footbath with herbs
Comparison	All possible control groups (such as placebo, interventions for pain management)	-
Outcome	All patients reported outcomes including pain (such as level of pain, pain severity)	-
Study Design	Randomized controlled trials Quasi-experimental studies	Qualitative studies, reviews/ systematic reviews, meta-analyses, inventions, books/book chapters pilot studies, case studies
Others	Language: English Full length publications	Grey literature (conference papers, abstracts, letters to editor, ongoing studies, unpublished article, etc.)

manually removed. Potentially relevant article titles and abstracts were retrieved by the two researchers independently (S.U and M.Y) to decide if each article meet the inclusion criteria. Among the abstract screening, the disagreements between authors were resolved asking a third independent academic researcher and consensus was reached by discussion. When the title and abstract was not clear to screen the purposes, the full text was retrieved as well. After that, all full texts of the articles were screened again by the researchers independently. The PRISMA flow diagram is presented in Figure 1.

**Data extraction**

The data extraction from the articles included study characteristics (e.g. author/s, publication year, country, design, sample size, participants), intervention characteristics (e.g. water temperature, duration of the footbath, outcome measurements) and primary results.

**Quality assessment**

The quality assessment was done independently by the authors using the Joanna Briggs Institute (JBI) Critical Appraisal checklists for randomized controlled trials (RCTs) and quasi-experimental studies.<sup>28,29</sup> The JBI Criti-

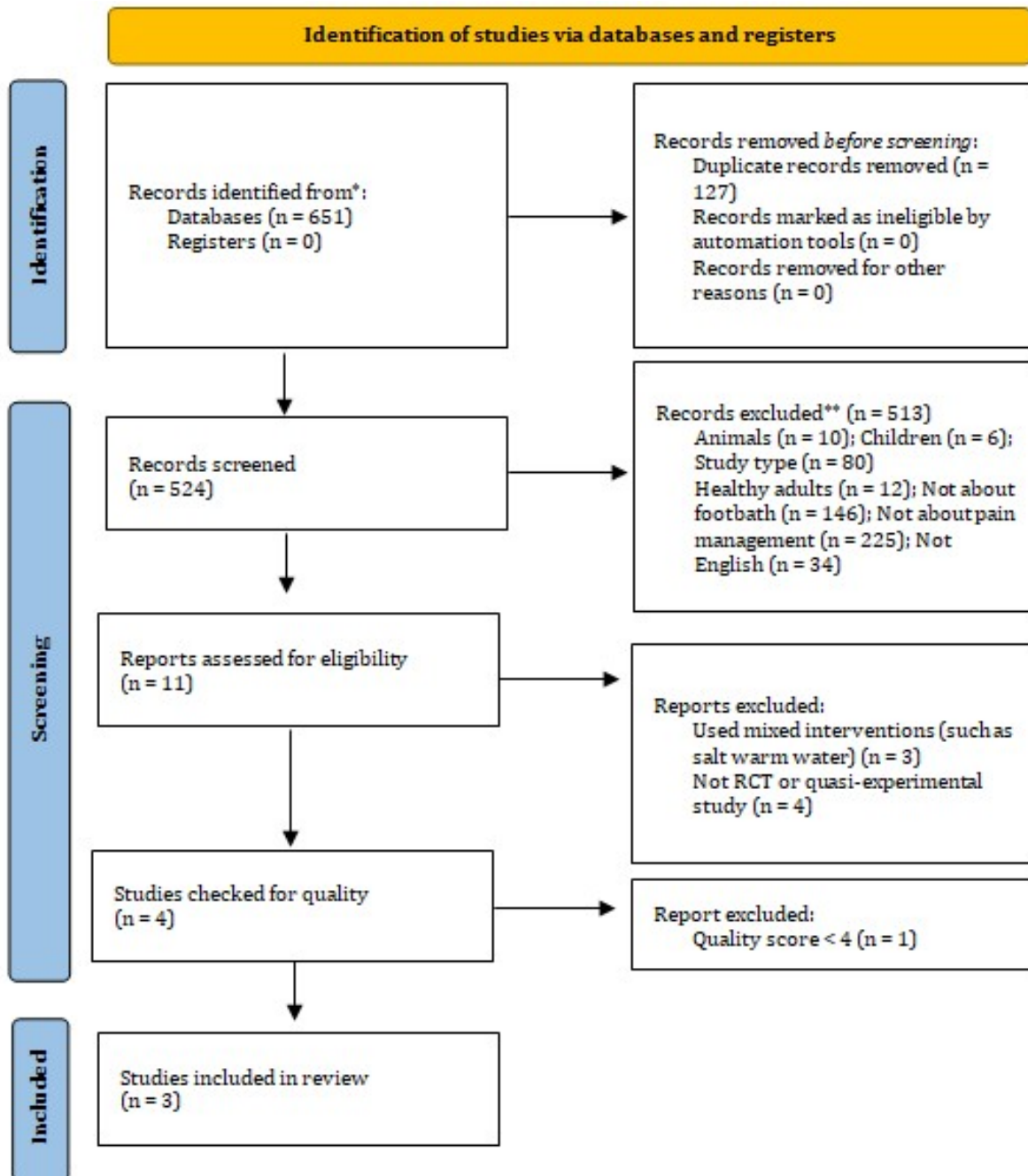


Figure 1 PRISMA flow diagram

\*312 Cochrane, 122 from Scopus, 73 from CINAHL, 72 from Pub Med and 72 from Web of Science

\*\*All were excluded by a human.

cal Appraisal checklists for RCTs includes a total of 13 items and the checklists for quasi-experimental studies includes 9 items to categorize studies as high quality or low quality.<sup>28-30</sup> Each item on the checklist is assessed as “yes”, “no”, “unclear”, or “not applicable”, and scored as 0 point-high risk of bias or 1 point-low risk of bias. The studies totally scored  $\geq 6$  points for RCTs and  $\geq 5$  points for quasi-experimental studies are accepted as high quality and included in the review.<sup>28-30</sup> Disagreements between the quality assessments scores were solved by a second consensus meeting within the two authors.

**RESULTS**

**Study selection**

Among the initial advanced search of the databases, 651 articles were obtained; 312 Cochrane, 122 from Scopus, 73 from CINAHL, 72 from Pub Med and 72 from Web of Science. After excluding 127 duplicated articles, remaining 524 abstracts were included for screening. At the screening step, 513 were excluded because inappro-

priate study design and population, no footbath intervention, no evaluation about pain severity, using mixed interventions (such as using foot massage and footbath together, using warm-water with salt or herbs) and 11 full-text articles were assessed for eligibility. Of the excluded seven studies, four were not RCT or quasi-experimental study and three had mixed interventions. Four studies were verified to meet the inclusion criteria and underwent for quality assessment. After completing the quality assessment, one quasi-experimental study was excluded because did not meet quality requirements (score < 4), and finally, three studies were included in this systematic review, one RCT<sup>23</sup> (Table 2) and two quasi-experimental studies<sup>19,31</sup> (Table 3).

**Study characteristics**

The included three studies were published between 2015-2020, carried out on participants who suffer from peripheral neuropathic pain and osteoarthritis joint pain, and carried in Indonesia,<sup>19</sup> Korea<sup>31</sup> and Iran.<sup>23</sup> Table 4 shows the included studies and their characteristics

**Table 2.** Quality assessment of the RCT study

	Was true randomization used for assignment of participants to treatment groups?	Was allocation to treatment groups concealed?	Were treatment groups similar at the baseline?	Were participants blind to treatment assignment?	Were those delivering treatment blind to treatment assignment?	Were outcomes assessors blind to treatment assignment?	Were treatment groups treated identically other than the intervention of interest?	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and as shown?	Were participants analyzed in the groups to which they were randomized?	Were outcomes measured in the same way for treatment groups?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?	Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and
Vakilinia et al., 2020	●	●	●	●	●	●	●	●	●	●	●	●	●
●	Yes												
●	Unclear												
●	No												
●	Not applicable												

**Table 3.** Quality assessment of the quasi-experimental studies

	Is it clear in the study what is the cause and what is the effect (i.e. there is no confusion about which variable comes first)?	Were the participants included in any comparisons similar?	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Was there a control group?	Were there multiple measurements of the outcome both pre and post the	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Were the outcomes of participants included in any comparisons measured in the same way?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?
Park et al., 2015	●	●	●	●	●	●	●	●	●
Hasan et al., 2019	●	●	●	●	●	●	●	●	●
●	Yes								
●	Unclear								
●	No								



**Table 4.** Description of the study characteristics, measurements and primary outcomes

First author (year)	Study design / Patients	Sample size	Measurements	Footbath intervention	Primary outcomes
Vakilinia SR (2020)	RCT / diabetic peripheral neuropathy	Warm-water n = 19 Saltwater n = 19 Control n = 16	DN4 questionnaire (7 item related to pain) Mcgill Pain Questionnaire	40°C-45°C temperature water for 15 minutes	Not effective
Park R (2015)	QEs / chemotherapy-induced peripheral neuropathy	Footbath n = 24 Foot massage n = 24	FACT/GOG-NT x scale (one item related to joint pain)	40°C temperature water for 30 minutes	Not effective
Hasan MI (2019)	QEs / osteoarthritis	Footbath n = 10 Control n = 10	WOMAC Index (five questions related to joint pain)	Not described	Effective

RCT = Randomized controlled trial, QEs = Quasi-experimental study, DN4 = Douleur Neuropathique 4, FACT/GOG-NTx = Functional Assessment of Cancer Therapy/Gynecologic Oncology Group-Neurotoxicity scale, WOMAC = Western Ontario McMaster Universities Arthritis Index

(such as author/s, publication year, study design, sample size, measurements, intervention, primary outcomes).

#### Intervention procedures

In Vakilinia et al.'s study,<sup>23</sup> water between 40°C-45°C temperature was used for 15 minutes among patients with painful diabetic peripheral neuropathy in the warm-water footbath group, every night before bedtime for one month. The footbath intervention was compared with two other groups including saltwater footbath group and control group. In the saltwater group, 250 grams of powdered mineral salt was dissolved in the water and other protocols were the same with warm-water footbath group. In Park et al.'s study,<sup>31</sup> water at 40°C temperature was used for 30 minutes among patients with chemotherapy-induced peripheral neuropathy in the intervention group, for a total of 8 treatments over 2 weeks. The footbath intervention was compared with other footbath with foot massage group. In this group, 10 minutes of foot massage on each foot was applied following 5 minutes of foot bathing. In Hasan et al.'s study,<sup>19</sup> the footbath intervention applied in the experimental group including elder patients who suffer from osteoarthritis joint pain was not explained in details. The footbath intervention was compared with control group that received no intervention.

#### Measurements

Across the three studies, the effects of footbath on pain management were evaluated by using different scales and electromyography technique. To evaluate the pain severity of patients with diabetic peripheral neuropathy, Douleur Neuropathique 4 questionnaire (DN4) which has seven items related to pain was used at the beginning, at the 15<sup>th</sup> and 30<sup>th</sup> days. In addition, McGill Pain Questionnaire was also used at the beginning and at the end of the study to evaluate pain over time.<sup>23</sup> In their study, Park et al.<sup>31</sup> used the Functional Assessment of Cancer Therapy/Gynecologic Oncology Group-Neurotoxicity (FACT/GOG-NTx) scale which has an item related to joint pain to evaluate the quality of life of cancer patients at the pre-test and post-test. In the evaluation of the osteoarthritis joint pain severity of elderly patients, the Western Ontario McMaster Universities Arthritis Index (WOMAC) which has five questions related to joint pain was conducted before and after

footbath intervention for experimental group while for the control group, the evaluation was performed directly.<sup>19</sup>

#### Effect of footbath on pain management

Reviewing the effect of warm-water footbath intervention on pain outcomes showed that, it was not effective to decrease pain of diabetic peripheral neuropathic patients (difference between warm-water and salt warm water group  $p=0.458$ ; difference between warm-water and control groups  $p=0.335$ ),<sup>23</sup> not effective in managing joint pain among patients with chemotherapy-induced peripheral neuropathy (difference between before and after footbath  $p=0.078$ )<sup>31</sup> and effective to decrease joint pain scores of patients with osteoarthritis (difference between experimental and control group  $p=0.035$ ).<sup>19</sup>

#### DISCUSSION

This systematic review highlights the potential benefits of warm-water footbath in managing pain, particularly for patients from different healthcare settings. While the review found limited effectiveness for types of pain, reviewed studies pointed out that warm-water footbaths were used for the management of diabetic peripheral neuropathy pain, joint pain of patients with chemotherapy-induced peripheral neuropathy and osteoarthritis-related joint pain.<sup>19,23,31</sup> Among these studies, warm-water footbath seems to be effective only for joint pain relief among elderly patients who have osteoarthritis. With the stimulation effect of warm water on joints, the blood circulation and the release of endorphin, the body's natural pain killers increase. It also improves vascularization of the synovium tissue and relaxes muscles.<sup>19,32</sup> The findings of this review suggest that incorporating warm-water footbaths into pain management protocols may be an effective strategy for alleviating osteoarthritis-related joint pain in elderly patients. Future research is needed to evaluate its efficacy in other types of pain and to establish standardized guidelines for its use in clinical practice.

In Park et al.'s study,<sup>31</sup> warm-water footbath was reported to be effective in peripheral neuropathy severity of patients undergoing chemotherapy by increasing the skin temperature but it was not effective in managing their joint pain. In the literature, heat therapy with ap-

plying footbath was reported to be the most influential intervention in reducing chemotherapy induced peripheral neuropathy (CIPN) severity symptoms during the 4 or 5 cycles of chemotherapy or >8 chemotherapy sessions in 2 weeks.<sup>33,34</sup> Although these results report that warm-water footbath is effective on the neuropathic symptoms and decreases sympathetic activation of body, its effect on pain levels is not specifically investigated, thus the effect on pain relief is unclear.<sup>33,34</sup> In a pilot study from Japan, the effect of warm-water footbath on pain relief among hospitalized patients with incurable cancer was investigated. They used 38-42°C water for 20 minutes after rubbing feet with olive oil and reported that it was effective to decrease sympathetic activity and to afford pain relief.<sup>35</sup> On the contrary, in a study conducted with cancer patients receiving taxane and platinum-based treatment reported cold-water footbath to be more effective in relieving pain than warm-water footbath.<sup>22</sup> Another study conducted with outpatient cancer patients receiving ongoing chemotherapy reported that, a 41-42 °C saltwater footbath (8L of water + 7 salt packages containing 280 g of iodized salt) for 20-min was effective in reducing muscle-joint pain.<sup>36</sup> The mixed findings from various studies highlight the need for more comprehensive research to understand the full potential of warm-water footbaths in pain management for chemotherapy-induced peripheral neuropathy patients. Additional studies on different temperatures, durations, and additional treatments may contribute to interventions that are more effective.

In the literature, it is reported that up to 50% of patients with diabetic peripheral neuropathy (DPN) experience neuropathic pain.<sup>37,38</sup> To manage with this pain, herbal footbaths and Chinese medicine footbath combined with drug injections were alternatively used and the efficacy of them were reported.<sup>39,40</sup> However, in this systematic review, it was determined that warm salt water footbath was more effective in reducing pain than warm-water footbath among diabetic patients with peripheral neuropathy.<sup>23</sup> Although the effect of applying hot water stimulates microcirculation on extremities, some these findings demonstrate that warm-water footbath alone is ineffective for relieving pain and that additional applications are required to disperse blood stasis (such as salt, herbals, drugs).<sup>23,40,41</sup> Despite the fact that the application of hot water stimulates microcirculation, it is clear that dissolving stasis requires more than just one application of hot water in a footbath. Adding further therapies such salt, herbs, or medications into warm-water footbaths seems to enhance the effectiveness of warm-water footbaths. Further studies are needed to develop and standardize these combined applications to provide better results.

In the literature, it is seen that the studies on the use of warm-water footbath in pain management of patients from various healthcare settings are limited. The results of this systematic review suggest that warm-water footbath is effective in reducing joint pain among elder patients who have osteoarthritis, but not effective for the DPN pain relief, and joint pain of patients with CIPN. The effects brought by warm-water footbath to osteoarthritis joint pain might be related to the effect of improving tissue vascularization and relaxing muscles. Although the non-pharmacological nature of warm-

water footbaths is a significant advantage and it has ease of implementation at healthcare or home settings, these studies are mainly limited to long term pain conditions. Promising results underline the significant need to conduct more RCTs in order to prove its effectiveness in pain relief. Additionally, its effects on acute pain such as surgical interventions are still unclear. Studies with different settings using similar conditions and examining patient-related and intervention-related factors can strengthen the evidence of warm-water footbath as a pain management intervention in the healthcare settings.

One of the limitations of this systematic review is that the literature search examined studies that focused on patient groups in healthcare settings. Therefore, studies conducted on healthy individuals or samples outside of healthcare environments were excluded from the review. Another limitation is that the literature search did not include those who used cold water or other applications (such as herbal treatments, physical therapy, etc.) in conjunction with the warm-water foot bath intervention. One other limitation was that the literature search was limited to five databases: Cochrane, Scopus, CINAHL, Pub Med, and Web of Science.

## CONCLUSIONS

Warm-water footbath seems to be an effective intervention for pain relief. However, its positive effect is limited to patients who have osteoarthritis joint pain. Results from this review also show that well-designed studies that investigate the clinical effects of footbath on patients with pain are insufficient. Given the limited number of studies in this area, it is recommended to conduct additional well-designed and comparative studies and develop and evaluate standardized protocols (such as duration, frequency, temperature etc.) of footbaths to prove the effectiveness of warm-water footbaths in relieving pain.

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