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Effect of Diabetic Foot Spa on Lower Extremity Circulation with Ankle Brachial Index in Patients with Diabetes Mellitus: A Systematic Review

Uti Uswatun Nisa[1], Sapta Rahayu Noamperani[2], Yunita Sari[3]

[1,3]Department of Nursing,, Faculty of Health Sciences, Universitas Jenderal Soedirman, Indonesia
[2]Department of Nursing, Health Polytechnic Ministry of Health, Yogyakarta, Indonesia

Corresponding author: yunita.sari@unsoed.ac.id

Abstract

Background: Foot care for diabetics is important because of the complications of diabetic neuropathy. One of the foot care for DM is diabetic foot spa. Research related to the benefits of foot spas is quite a lot. Still, research related to the effectiveness of diabetic foot spas in influencing the quality of lower extremities circulation of DM patients with an indicator of increasing the value of ankle brachial index (ABI) is still minimal. **Purpose:** To assess the effectiveness of the diabetic foot spa on the lower extremity circulation with the ABI as an indicator of diabetes mellitus patients. **Method:** This systematic review refers to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The search was limited to articles with the type of original research. The databases used are Google Scholar, ProQuest, PubMed, National Library, and ScienceDirect. Assessment of article quality is carried out using JBI's Critical Appraisal Tools checklist. **Result:** The search results obtained 214 articles. The article was continued with the identification, screening, eligibility, and inclusion process so that 3 articles included in this study which will be carried out in the review process. The review results showed that the diabetic foot spa intervention is effective in improving the lower extremities circulation with an indicator of increasing the ABI value of DM patients. **Conclusion:** Diabetic foot spa effectively increases the circulation of the lower extremities, characterized by an increase in the ABI value in DM patients.

Keywords:
Diabetic foot spa; foot circulation; ankle brachial index.

Abstrak

Latar belakang: Perawatan kaki bagi penderita diabetes merupakan hal yang penting karena adanya komplikasi neuropati diabetes. Salah satu perawatan kaki yang dapat dilakukan adalah *diabetic foot spa*. Penelitian terkait dengan manfaat spa kaki sebenarnya sudah cukup banyak namun penelitian terkait keefektifan spa kaki diabetik dalam mempengaruhi kualitas sirkulasi ekstremitas bawah penderita DM dengan indicator peningakatan nilai *ankle brachial index* (ABI) masih sangat terbatas. **Tujuan:** Untuk menilai keefektifan *diabetic foot spa* terhadap sirkulasi ekstremitas bawah dengan indikator nilai *ankle brachial index* pada penderita diabetes melitus. **Metode:** *Systematic review* ini mengacu kepada *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA). Pencarian dibatasi pada artikel dengan jenis penelitian original riset. Database

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yang digunakan adalah *Google scholar, proquest,* PubMed*,* Perpusnas *dan sciencedirect*. Penilaian kualitas artikel dilakukan dengan *JBI's Critical Appraisal Tools checklist.* **Hasil:** Hasil pencarian dari kelima database diperoleh 214 artikel. Artikel tersebut kemudian dilanjutkan dengan proses *identification, screening, eligibility*, dan *include* sehingga diperoleh 3 artikel yang dilakukan proses *review*. Hasil *review* menunjukkan intervensi *diabetic foot spa* efektif melancarkan sirkulasi ekstremitas bawah dengan indikator peningkatan nilai ABI penderita DM. **Kesimpulan:** *Diabetic foot spa* efektif dalam meningkatkan sirkulasi ektremitas bawah ditandai dengan peningkatan nilai ABI pada pasien DM.

Kata Kunci: *spa kaki diabetes, sirkulasi kaki, dan ankle brachial index*

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that is still a concern in Indonesia and the world because of its ever-increasing incidence. According to the World Health Organization (WHO), in 2015, the prevalence of DM worldwide reached 642 million people. Indonesia has the highest number of people with diabetes, ranking sixth with 10.3 million sufferers (International Diabetic Federation 2015). Based on the Basic Health Research (Riskesdas) (2018), there was an increase in people with diabetes mellitus from 6.9% in 2013 to 8.5% in 2018.

In general, DM is a metabolic disease caused by a lack of the hormone insulin so that glucose cannot enter cells, and hyperglycemia occurs (Guyton & Hall 2007). Uncontrolled hyperglycemia conditions for a long time make diabetes mellitus patients susceptible to the emergence of various complications. The increasing incidence of DM causes an increase in the incidence of complications macrovascular (coronary heart disease, stroke) and microvascular (retinopathy, nephropathy, neuropathy) (Black & Hawk 2009). Microvascular complications include damage to the eyes (retinopathy), which causes blindness, damage to the kidneys (nephropathy), which leads to kidney failure, peripheral arterial disease, and also damage to nerves (peripheral neuropathy) which results in diabetic foot disorders to the possibility of amputation of the limbs (Suyanto 2017).

One of the most common complications of DM is the peripheral arterial disease which can also cause diabetic neuropathy. Peripheral arterial disease is closely related to circulatory disorders of blood flow. This happens because of viscosity, one of which is caused by the buildup of excessive blood sugar levels that affect the function of blood platelets. The viscosity of the blood results in impaired blood flow, resulting in decreased perfusion of

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blood flow to the lower extremities to carry nutrients and oxygen to nerve fibers (Ibrahim, Sofiani & Irawati 2020). This incidence occurs between 60% to 70% in DM patients, which will cause common initial symptoms, including; distal paresthesias, pain like aching/burning, stabbing, and cold feet. Other manifestations include the reduced sensation of protection, pain, temperature, touch vibration (Suyanto 2017).

The reduced sensation of protection due to impaired peripheral circulation puts DM patients at risk for injury to the peripheral areas, especially the feet. Diabetic feet that are not appropriately treated will easily get injured and quickly develop into diabetic ulcers and end in amputation if not treated properly. Every year more than 1 million people with diabetes lose one of their legs as a complication of diabetes (Sakinah et al. 2020).

Prevention of peripheral arterial disease and diabetic ulcers can be done by modifying lifestyle and doing foot care. One form of foot care that can be carried out is a diabetic foot spa (Djafar, Nur & Azzam 2019). Diabetic foot spa is a series of activities and foot care activities starting from foot exercises, cleansing/soaking the feet with warm water, and foot massage so that they can launch and improve peripheral blood circulation and increase a sense of comfort and relaxation (Ibrahim, Sofiani & Irawati 2020).

Peripheral circulation disorders can be detected by looking at the value of the Ankle Brachial Index (ABI). ABI is one indicator to see a decrease in blood flow perfusion to the leg/lower extremity area by measuring the ratio of systolic pressure in the arm/brachial and systolic pressure in the legs. The ABI value is calculated by dividing the systolic pressure between the arm and the systolic pressure in the portion. ABI value > 1.0 is said to normal, and if < 0.91 is said to be at risk for peripheral circulation disorders (Ibrahim, Sofiani & Irawati 2020).

Research conducted by Sakinah et al. (2020) mentioned that giving a foot spa technique effectively improves blood circulation in DM patients by increasing the ABI value. Implementation of foot care; diabetic foot spa starts from foot exercise activities, cleaning/soaking the feet with warm water, and foot massage, which help improve peripheral blood circulation to prevent complications in DM sufferers. Based on this, it is necessary to provide information regarding the effectiveness of diabetic foot spas in improving blood circulation, considering the importance of foot care in DM patients. Research related to the benefits of foot spas is quite a lot. However, research related to the effectiveness of diabetic foot spas in affecting the circulation of the extremities is still minimal. Based on this, the

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author conducted a literature study on "Systematic Review: The Effect of Diabetic Foot Spa on Lower Extremity Circulation with Ankle Brachial Index Value Indicators in Patients with Diabetes Mellitus."

The purpose of writing this systematic review is to determine and assess the effectiveness of the effect of diabetic foot spa in improving circulation of the lower extremities with the ankle-brachial index as an indicator in patients with diabetes mellitus.

METHOD

Data Sources and Searches

The design of this article is a systematic review concerning the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).Article searches were conducted electronically from the databases of Google Scholar, PubMed, Sciencedirect, National Library and Proquest from 2011 to 2021. The results of the literature search are then documented in the PRISMA chart.

Article searches are carried out by the author based on the PRISMA flow which includes the stages of identification, screening, eligibility, and including articles, in order to obtain articles that will be reviewed. Based on search results on Google Scholar, PubMed, Sciencedirect, Proquest and National Library with the keywords:

1. “diabetic foot spa”
2. “foot spa” AND diabetic AND foot circulation
3. “foot spa” AND diabetic AND “ankle brachial index”

Study Selection

A systematic review was carried out with the PICO model. P: people with diabetes mellitus, I: diabetic foot spa, C: whether or not there is a control group compared with the intervention group. O: lower extremity circulation with ankle-brachial index value indicator.

The keywords used are "diabetic foot spa" and foot circulation" or "ankle-brachial index" and diabetic. Article searches were conducted electronically from Google Scholar, PubMed, ScienceDirect, National Library, and ProQuest. The article inclusion criteria used include; articles from 2011 to 2021, in English, accessible and have full text, primary or pure research results, involving people with diabetes mellitus as respondents, there is a diabetic foot spa intervention, and the outcome of the study is lower extremity blood circulation (foot perfusion) with the indicator of the value of the ankle brachial index (ABI). The exclusion

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criteria include; articles unrelated to diabetic foot spa and lower extremity blood circulation (foot perfusion) with ankle brachial index (ABI) value indicator, and articles in literature reviews, systematic reviews, and meta-analysis.

Data Extraction and Quality Assessment

From the keywords used, the articles obtained from electronic searches through a database were 214 articles. The same title was excluded from the article search process. This process is done automatically by the application and manually. After that, a check is made on the title's relevance to the topic to be reviewed. Search for articles with relevant titles, followed by checking the contents of the abstract. Abstract content that is not relevant to the topic and does not meet the criteria of the article is excluded from the search process. After screening the abstracts, four articles were obtained. After that, the article search was continued by viewing the full-text article.

Assessment of article quality was carried out using JBI's Critical Appraisal Tools checklist for research using quasi-experimental studies (non-randomized experimental studies) to assist in assessing the reliability, relevance, and results of published articles.The four articles were assessed for article quality using the JBI'S Critical Appraisal Tools checklist, and three articles were obtained that passed the qualifications and will be reviewed.

In detail, the PRISMA process will be explained in the following figure;

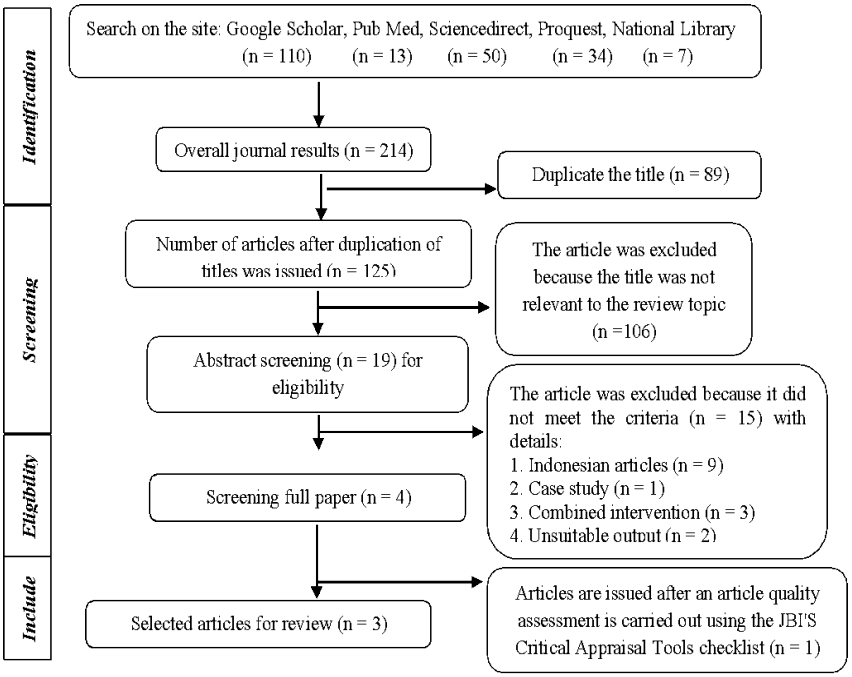

Figure 1. Article Searched Flowchart Based on PRISMA

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Analysis (for Meta-Analysis or Meta-Synthesis)

From the keywords used, the articles obtained from electronic searches through a database were 214 articles. The author then without all the articles obtained from the five databases used and checks for duplication of titles. The same title was excluded from the article search process. This process is done automatically by the application and manually. The number of duplicated titles is 89 articles, so that the articles that enter the next stage are 125 articles.

After that, a check is made on the relevance of the title to the topic to be reviewed. Titles that do not match the topic of study are excluded from the search process. The number of titles issued because they were not in accordance with the topic review was 106, so the articles that entered the next stage were 19 articles. The article search was followed by checking the contents of the abstract.

Abstract content that is not relevant to the topic and does not meet the criteria of the article, is excluded from the search process. After abstracting, 15 articles were excluded because they did not meet the inclusion criteria, so the remaining 4 articles. After that, the article search was continued by viewing the full-text article. Articles that meet the inclusion criteria and have no problems in terms of the research methodology and pass the article assessment will be involved in the article review process.

Assessment of article quality was carried out using JBI's Critical Appraisal Tools checklist for research using quasi-experimental studies (non-randomized experimental studies) to assist in assessing the reliability, relevance, and results of published articles.There are four articles that are assessed for quality, there is one article that excludes because unclear so that there are three articles that are included for the review process.

RESULT

The results of a literature search conducted on Google Scholar, PubMed, ProQuest, Science Direct, and the National Library and referring to PRISMA obtained three articles that were reviewed. The results of the third article review are as follows:

Table 1. Article Review

Author	Journal	Population	Intervention	Outcome
Erika Martining Wardani, Chilyatiz	*Diabetic Foot Spa Implementation in Early*	The sample used in this study were people with diabetes mellitus	Diabetic foot spa consists of diabetic foot exercise, skin cleansing, including	Peripheral blood circulation with the value of the ankle branchial index, foot sensitivity,

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Author	Journal	Population	Intervention	Outcome
Zahroh and Nur Ainiyah	*Neuropathy Diagnosis Based on Blood Glucose Levels, Foot Sensitivity and the Ankle Brachial Index in Patients with Diabetes Mellitus*	as many as 30 respondents from 170 populations selected by simple random sampling.	pedicure and foot mask. When cleaning the feet, while soaking the feet in warm water at 40-42ºC, they were then followed by foot massage by applying moisturizing cream. Diabetic foot spa did ± 30 minutes for three days. When doing a foot massage, it is also combined with reflexology focused on the reflex point area of the foot, which also makes the blood circulation system smooth.	and decreased blood glucose levels. The average value of the ankle branchial index score after the intervention had increased from 0.8 to 0.94. This study indicates that diabetic foot spa has a significant effect on increasing the value of the ankle brachial index.
Rahmi Affiani, and Puji Astuti	*The effectiveness diabetic foot spa to peripheral blood Circulation of dm type 2 patient in Puskesmas Wonokromo Surabaya*	The population of this study were all type 2 DM patients in the Wonokromo Public Health Center Surabaya. The number of samples used were 46 people which were divided into 23 people in the treatment group and 23 people in the control group.	Diabetic foot spa includes diabetic foot exercises, skin cleansing, cleaning using baby bath soap, pedicure if the respondent has medium-length nails, foot mask to clean dead skin cells, but not every day so that the skin layer does not get thinner. The last is foot massage, which is a superficial massage of the feet to increase blood circulation. This diabetic foot spa was carried out for ±30 minutes for five consecutive days in the treatment group.	Peripheral blood circulation before and after the diabetic foot spa was measured by the value of the ankle brachial index. The pretest measurement of the intervention group mostly (52.5%) had peripheral blood circulation in the mild category. After the intervention for five days, the post-test measure of the treatment group almost entirely (91.3%) experienced an increase in peripheral blood circulation to the standard category. At the same time, the control group did not experience significant changes. Therefore, the diabetic foot spa is effective on peripheral blood circulation, indicating an increase in the ABI value.
Abdul Aziz Alimul Hidayat, Ricky Riyanto Iksan,	*Improving Foot Peripheral Blood Circulation with Indicators*	The population in this study were patients with type 2 diabetes mellitus who were treated at the Pelni Hospital in	The intervention was giving diabetic foot spa procedures to patients with diabetes mellitus to avoid complications of peripheral arterial disease. This is done	The pretest measurement of 62 respondents obtained 38 people (61.3%) had a peripheral circulation in the normal category (38.7%) in mild obstruction. The results

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Author	Journal	Population	Intervention	Outcome
Buntar Handayani, Isnayati, and Rona Febriyona	*of Ankle Brachial Index (ABI) through Diabetic Foot Spa in Diabetes Mellitus Patients of Type 2*	Jakarta. This study used a purposive sampling technique with a total sample of 62 respondents who met the inclusion criteria.	routinely, consisting of foot exercises, soaking the feet with warm water (skin cleansing), and foot massage, which is done for 45 minutes per day for five days.	of posttest measurements 56 people (90.3%) had a peripheral circulation in the normal type, and only six people (9.7%) had a peripheral circulation in the type of mild obstruction. A diabetic foot spa can effectively improve peripheral circulation with an indicator of increasing the ABI value.

Table 2 . JBI Critical Appraisal Checklist for Quasi-Experimental Studies
(non-randomized experimental studies)

No.	Item	Artikel 1	Artikel 2	Artikel 3	Artikel 4
1.	*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)?.*	Y	Y	Y	Y
2.	*Were the participants included in any comparisons similar?.*	Y	Y	Y	Y
3.	*Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?.*	Y	Y	Y	Y
4.	*Was there a control group?.*	Y	Y	Y	N
5.	*Were there multiple measurements of the outcome both pre and post the intervention/exposure?.*	Y	Y	U	Y
6.	*Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?.*	Y	Y	U	Y
7.	*Were the outcomes of participants included in any comparisons measured in the same way?.*	Y	Y	Y	Y
8.	*Were outcomes measured in a reliable way?.*	Y	Y	U	Y
9.	*Was appropriate statistical analysis used?.*	Y	Y	Y	Y
	Kesimpulan	Include	Include	Exclude	Include

Yes (Y), No (N), Unclear (U), Not Applicabble (NA)

DISCUSSION

Based on the article review results, it was found that the diabetic foot spa was effective in improving peripheral blood circulation with an indicator of increasing the value of the ankle-brachial index (ABI). According to research conducted by Wardani, Zahroh & Ainiyah (2019) that the diabetic foot spa treatment performed for 30 minutes every day for three days can increase the ankle-brachial index score. This study also obtained results that diabetic foot spa affects blood glucose levels and foot sensitivity in people with diabetes mellitus. The article also explains in sufficient detail the effect of diabetic foot spa on blood glucose levels, foot sensitivity, and also ankle-brachial index scores. According to the research conducted by Affiani & Astuti (2018) showed a result that diabetic foot spa performed for 30 minutes for five days effectively improved peripheral blood circulation by increasing the ankle-brachial index score from mild obstruction to normal. The more regular the diabetic foot spa is done, the better the peripheral blood circulation to prevent complications in people with diabetes mellitus.

The effectiveness of the diabetic foot spa in increasing blood circulation as measured by increasing the ABI value is also supported by the third article by Hidayat et al. (2021). The diabetic foot spa treatment carried out for 45 minutes every day, for a total of 5 days in DM patients can improve peripheral blood circulation which is marked by an increase in the ankle-brachial index score. Therefore, diabetic foot spa can be used as therapy in increasing peripheral blood circulation in type 2 diabetes mellitus patients. In this third article, there are differences in the duration of the diabetic foot spa implementation with the first and second articles. The results showed that the diabetic foot spa increased blood circulation by increasing the ABI value. From the three articles analyzed, the results show that the series of diabetic foot spa activities are conceptually the same, namely by doing foot exercises, foot cleaning, and foot massage. Two articles explain in great detail, and one article describes in more minor detail.

The three articles that have been analyzed show that the diabetic foot spa treatment is effective in improving peripheral blood circulation, which is characterized by an increase in the value of the ankle brachial index (ABI) in patients with diabetes mellitus. The research conducted still has research limitations, namely the researcher did not examine the characteristics of the respondents that may have a relationship with foot sensitivity and blood

sugar levels. The characteristics that were not examined include culture, food consumption, daily activities carried out, and patient compliance in carrying out therapy recommended by doctors, nurses, and other health workers.

Foot care range; diabetic foot spa begins with diabetic foot exercises, skin cleansing is cleansing using a soft and mild baby bath soap, a pedicure is cutting and scraping nails if the respondent has medium-length nails, foot mask is the act of giving a scrub with the aim of cleaning cells dead skin but for this action is not done every day so that the skin layer does not get thinner. During skin cleansing, soak your feet in warm water. After the skin cleansing is complete and the feet have been dried, the activity is continued with foot massage, which is a superficial massage of the feet. In addition, apply a moisturizing cream to the skin to avoid dry skin. This series of diabetic foot spas is implemented for ± 30 minutes each time of therapy and can be done regularly every day.

From every range of foot care; Diabetic foot spa can not only improve blood circulation but also make patients feel comfortable and relaxed. Foot exercise is one way to increase circulation, especially in the feet, to increase the protection of the skin (Prihatin & Dwi M 2019). Foot exercises that can be done based on the analysis of the three articles are diabetic foot exercises and aerobic foot exercises. Diabetic foot exercise is effective in influencing the ABI value, and this shows that foot exercise can improve leg blood circulation (Megawati, Utami & Jundiah 2020). Aerobic foot exercises can also be done by focusing on variations in movement in the leg area that meet the criteria of continuous, rhythmic, interval, progressive, and focused on endurance (Wahyuni 2016). The recommended exercise for people with diabetes is aerobic, meaning that it requires oxygen which can help improve blood circulation, strengthen the main muscles of the legs, prevent foot deformities which can reduce the potential for diabetic foot injuries, and increase endurance (Wardani, Zahroh & Ainiyah 2019).

During skin cleansing, the client's feet are soaked in warm water. Based on the results of a review of the three articles, the temperature of the warm water used for warm water baths is 40 – 42º C. Soaking the feet in warm water can increase blood circulation, reduce edema and increase circulation to increase muscle relaxation (Mataputun, Prabawati & Tjandrarini 2020). The heat of warm water can cause dilation of blood vessels which causes increased blood circulation and relieves pain (Zahroh & Faiza 2018). Warm water therapy helps

improve blood circulation, reduce the stiffness of muscle tone, activate a feeling of relaxation, stimulating nerve endings, causing a feeling of freshness, and an analgesic and sedative effect (Priyanto, Sahar & Widyatuti 2013).

The last series of diabetic foot spa activities is foot massage. Foot massage or foot massage is crucial because it can increase the secretion of endorphins in the body, which functions to reduce pain and cause vasodilation of blood vessels to improve blood circulation (Laksmi et al., 2013). In Wardani, Zahroh & Ainiyah's research (2019) that foot massage can be combined with massage with a bit of emphasis on the point between the thumb and the index finger. Repetition can also be focused on the foot's reflex point area, which also makes the circulatory system smooth. It can make the circulatory system smooth because of the bioelectricity stimulation that helps destroy clots in the bloodstream, thereby helping neutralize excess carbohydrates in the blood (Mahendra et al., 2008).

Related to the time in the implementation of diabetic foot spa treatment, it can be done for 30 minutes in one treatment. After doing it regularly for three days, it can improve peripheral blood circulation, which is marked by an increase in the ankle brachial index (ABI) value. After 5 days, it can increase circulation from mild to normal. The more routinely performed diabetic foot spa in DM patients, the better peripheral blood circulation to prevent DM complications. Given the importance of foot care in people with diabetes mellitus, diabetic foot spas can be used as a safe foot care option to be done every day for people with diabetes. However, regarding skin cleansing; foot mask (give a scrub) needs to be considered so that it is not done every day to avoid thinning skin.

CONCLUSION

Based on the three articles that have been analyzed, the results show that foot care: diabetic foot spa is effective in improving the circulation of the lower extremities, which is indicated by an increase in the value of the ankle brachial index. The diabetic foot spa care activities consist of foot exercises, foot cleansing accompanied by foot soaking in warm water, and foot massage. This series of diabetic foot spas is implemented for ± 30 minutes each time of therapy and can be done regularly every day. The more routinely performed diabetic foot spa in patients with diabetes mellitus, the peripheral blood circulation is also getting better in preventing complications of diabetes mellitus. The combination of foot

massage can also be done by pressing on the point between the thumb and forefinger to increase blood circulation.

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