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# THE EFFECT OF DIABETIC FOOT EXERCISE USING A PLASTIC BALL ON DIABETIC NEUROPATHY AND CAPILLARY REFILL TIME IN PEOPLE WITH DIABETES MELLITUS TYPE 2

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**ABSTRACT**

Complications of Type 2 diabetes mellitus (DM) could cause peripheral nerve disorders or diabetic neuropathy and reduced blood circulation in the legs. The management of chronic complications in individuals with Type 2 DM included performing diabetic foot exercises using a plastic ball. However, the use of a plastic ball was rarely taught to people with diabetes. This study aims to analyze the effect of diabetic foot exercises using a plastic ball on diabetic neuropathy and capillary refill time (CRT) in individuals with Type 2 DM at the Mojolangu Public Health Center in Malang. This research was a quasi-experimental study with a pretest-posttest control group design and employed purposive sampling, involving 36 respondents. Data were collected using the DNS-score questionnaire and CRT physical examination. The data were analyzed using the Wilcoxon signed-rank test. The results of the Wilcoxon signed-rank test have shown a p-value of 0.012 ($p < 0.05$) for pretest-posttest neuropathy and a p-value of 0.046 ($p < 0.05$) for pretest-posttest CRT. The study concludes that diabetic foot exercises using a plastic ball significantly affected diabetic neuropathy and capillary refill time in individuals with Type 2 DM at the Mojolangu Public Health Center in Malang. It is recommended that health workers provide education and support for individuals with DM to perform diabetic foot exercises using a plastic ball correctly and regularly to help prevent worsening of neuropathy complications.

***Kata Kunci:***

*Kaki diabetes;*
*Neuropati;*
*Senam Kaki Bola Plastik;*



***ABSTRAK***

*Komplikasi diabetes melitus tipe 2 (DM) dapat menyebabkan gangguan pada saraf perifer (neuropati diabetik) serta penurunan sirkulasi darah pada ekstremitas bawah. Salah satu upaya penanganan komplikasi kronis pada penderita DM tipe 2 adalah melalui latihan kaki diabetik menggunakan media bola plastik. Namun, penggunaan bola plastik dalam latihan kaki ini masih jarang diberikan kepada pasien diabetes. Penelitian ini bertujuan untuk menganalisis pengaruh latihan kaki diabetik menggunakan bola plastik terhadap derajat neuropati diabetik dan waktu pengisian kapiler (capillary refill time/CRT) pada penderita DM tipe 2 di Puskesmas Mojolangu, Kota Malang. Penelitian ini merupakan studi kuasi-eksperimen dengan desain pretest-posttest dengan kelompok kontrol, menggunakan teknik purposive sampling dan melibatkan 36 responden. Instrumen yang digunakan meliputi kuesioner DNS-score untuk menilai neuropati dan pemeriksaan fisik untuk mengukur CRT. Analisis data dilakukan menggunakan uji Wilcoxon signed ranks. Hasil menunjukkan adanya pengaruh signifikan latihan kaki diabetik terhadap neuropati dengan nilai $p = 0,012$ ($p < 0,05$), dan terhadap CRT dengan nilai $p = 0,046$ ($p < 0,05$). Kesimpulannya, latihan kaki diabetik menggunakan bola plastik berpengaruh signifikan dalam menurunkan derajat neuropati diabetik dan memperbaiki waktu pengisian kapiler pada penderita DM tipe 2. Oleh karena itu, disarankan kepada tenaga kesehatan untuk memberikan edukasi dan pendampingan kepada pasien agar melakukan latihan kaki secara benar dan teratur guna mencegah perburukan komplikasi neuropati.*

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## INTRODUCTION

Diabetes is one of the most common health problems in Indonesia. Diabetes mellitus (DM) is classified into several types, namely type 1 DM (Insulin-Dependent Diabetes Mellitus), type 2 DM (Non-Insulin-Dependent Diabetes Mellitus), gestational DM, and DM associated with other diseases. Diabetes mellitus carries a risk of complications, one of which is vascular disorders that lead to poor blood circulation. This can cause problems in the extremities, particularly the feet, making them susceptible to vascular blockages and impaired perfusion in peripheral tissues . Acording to data from the International Diabetes Federation (IDF) in 2019, the number of people with DM increased to 463 million, with a prevalence rate of 9.3% among individuals aged 20–79 years (Saputri, S., Minarningtyas, A., Puspitasari, 2023). Furthermore, the frequency of complications among diabetes patients is 15% in type 1 DM and 85% in type 2 DM. The highest incidence of peripheral neuropathy is found in people with type 2 DM, at approximately 50.8%, while in type 1 DM it is around 25.6% (Yasa, 2019).

Data from the Malang City Health Office in 2022 reported that the Mojolangu Public Health Center ranked third, with 2,245 diabetes patients having received health services. Based on preliminary studies and data from the Mojolangu Health Center, there were 1,305 people with type 2 DM receiving routine treatment within the past year, and 78 patients who had been regularly and well-controlled in the past month, with or without peripheral neuropathy complications.

Peripheral neuropathy is the most common complication experienced by patients with type 2 DM. The discomfort associated with diabetic neuropathy may lead to diabetic vasculopathy, which causes vascular blockages and affects distal tissue perfusion. In general, individuals with type 2 DM experience impaired foot circulation, especially in the toes. Good peripheral perfusion can be indicated by a capillary refill time (CRT) of less than 2 seconds, supported by normal oxygen saturation levels (Heru Purnomo, Mu'awanah, M.Nor Mudhofar, Ajeng T Normawati, 2020). As a non-pharmacological strategy to prevent the worsening of neuropathy complications, diabetic foot exercises using a plastic ball can serve as an easy-to-perform intervention, recommended at least three times a week. Diabetic foot exercises involve movements that engage the muscles and joints of the feet (Setianingrum, 2020).

Plastic ball media are easy for patients to use. Rolling a plastic ball back and forth, especially on problematic areas of the soles, can help improve blood circulation. The soles of the feet contain nerve points connected to the pancreas, which influence insulin production. As a result of this stimulation, cold feet may become warmer, stiff feet may become more flexible, numbness may decrease, and atrophic feet may gradually return to normal (Oktaviah, D., Hasneli, 2014).

Based on the aforementioned problems, particularly complications in the feet such as neuropathy in patients with type 2 DM, the researchers aimed to conduct a study on the effect of diabetic foot exercises using plastic balls on diabetic neuropathy and capillary refill time. This study aims to determine the effect of these exercises on neuropathy and CRT in individuals with type 2 DM. The results of this research are expected to contribute to the advancement of nursing science in the future.

## METHOD

### Types, Location, and Time of Research

This study was a quasi-experimental research using a pretest-posttest control group design. The research was conducted at the Mojolangu Public Health Center, Malang, East Java, from April 1 to May 1, 2024.

### Population and Sample

The population in this study consisted of all patients with Type 2 Diabetes Mellitus (T2DM) in the working area of the Mojolangu Public Health Center. The sampling technique used was purposive sampling. A total of 36 respondents were selected based on inclusion and exclusion criteria and were then divided into two groups: the treatment group and the control group. The number of samples was determined using an a priori power analysis with G*Power software, assuming a significance level of 5%, statistical power of 80%, and a moderate effect size (d = 0.5), resulting in a minimum of 18 participants per group. This confirms that the total sample size used in this study was

adequate to detect the expected effect.

### Research Instrument

The instrument used to measure the independent variable—diabetic foot exercise using a plastic ball—was based on a Standard Operating Procedure (SOP) that had been previously validated and used in earlier studies.

For the dependent variable, diabetic neuropathy was measured using the Diabetic Neuropathy Symptom (DNS) questionnaire. This instrument consists of 4 yes/no questions. Each "yes" answer is scored as 1, and each "no" as 0, with a total possible score ranging from 0 to 4. The interpretation is as follows: a score of 0 indicates no neuropathy, a score of 1 indicates mild neuropathy, scores of 2–3 indicate moderate neuropathy, and a score of 4 indicates severe neuropathy. The DNS questionnaire used in this study was the Indonesian version that had undergone a validity and reliability test. According to (Mardastuti, Y., Asmedi, A., Gofir, 2016), the instrument demonstrated good validity and had a Cronbach's alpha value above 0.7, indicating high internal consistency.

Capillary refill time (CRT), as another dependent variable, was measured through direct physical examination following established SOPs. The procedure involved pressing the tip of the patient's fingernail for three seconds and observing the time it took for the nail bed to return to its normal color. A refill time of less than 2 seconds was categorized as normal, whereas a time of more than 2 seconds was considered abnormal.

Data were collected using a pretest-posttest approach. The intervention in the treatment group was conducted three times a week for two weeks. Measurements of DNS and CRT were taken both before and after the intervention.

### Data Analysis

Data were analyzed using the Wilcoxon Signed Ranks Test, as the results of the Shapiro-Wilk test indicated that the data were not normally distributed. This non-parametric test was used to compare two paired groups: the pretest and posttest scores in both the treatment and control groups. A significance level of 0.05 was applied to determine statistical significance.

## RESULTS

### A. General data

**Table 1. Frequency Distribution of Characteristics of Respondents**

| Respondent Characteristics | Frequency (F) | Percentage (%) |
|---|---|---|
| **Age** | | |
| Mean | 58.28 | - |
| Minimum - Maximum | 44 - 72 | - |
| **Gender** | | |
| Male | 10 | 27.8 |
| Female | 26 | 72.2 |
| **Last Education** | | |
| Elementary school | 14 | 38.9 |
| Junior High School | 8 | 22.2 |
| High school/high school | 8 | 22.2 |
| Diploma/Bachelor | 5 | 13.9 |
| No school | 1 | 2.8 |
| **Work** | | |
| Doesn't work | 9 | 25.0 |
| Self-employed | 16 | 44.4 |
| Housewife | 11 | 30.6 |
| **Long Suffering from DM** | | |
| Less than 5 years | 9 | 25.0 |
| More than 5 years | 27 | 75.0 |

Based on the results in Table 1, the majority of respondents were female, totaling 26 individuals (72.2%). Nearly half of the respondents had an elementary school education, accounting for 14 individuals (38.9%). In terms of occupation, 16 respondents (44.4%) were self-employed. Furthermore, most respondents (27 individuals or 75.0%) had been living with diabetes mellitus for more than five years.

**B. Custom Data**

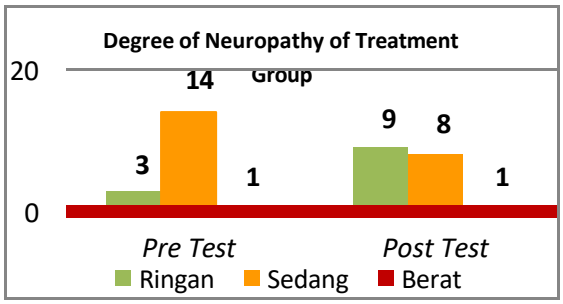


**Diagram 1. Degree of Diabetic Neuropathy *Pretest-Posttest* Treatment Group**

Based on the results of diagram 1, the degree of diabetic neuropathy in the treatment group before *(pretest)* was given the diabetic foot exercise intervention using a plastic ball, namely, 14 people experienced a moderate degree of neuropathy. After the posttest, the diabetic foot exercise intervention was given using a plastic ball, and 9 people experienced mild neuropathy.

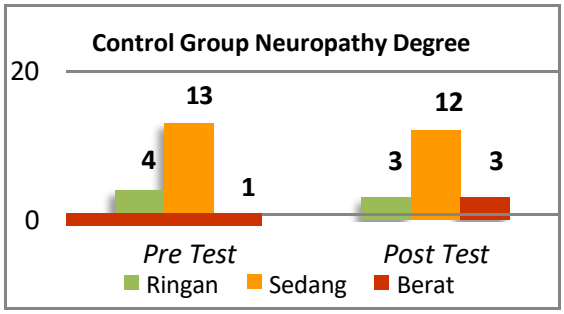


**Diagram 2. Degree of Diabetic Neuropathy *Pretest-Posttest* Control Group**

Based on diagram 2, the results show that the *pretest degree of diabetic neuropathy* in the control group who were not given intervention was 13 people who experienced a moderate degree of neuropathy. Meanwhile, *the posttest* results showed the degree of diabetic neuropathy, namely that 12 people experienced a moderate degree of neuropathy.

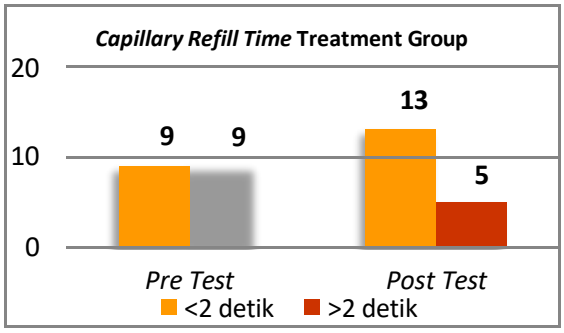


**Diagram 3. *Capillary Refill Time* Values *Pretest-Posttest* Treatment Group**

Based on diagram 3, it is shown that the capillary refill time value in the pretest intervention treatment group was 9 people with normal capillary refill time, namely <2 seconds. Then the intervention posttest, namely, 13 people with normal capillary refill time values of <2 seconds.

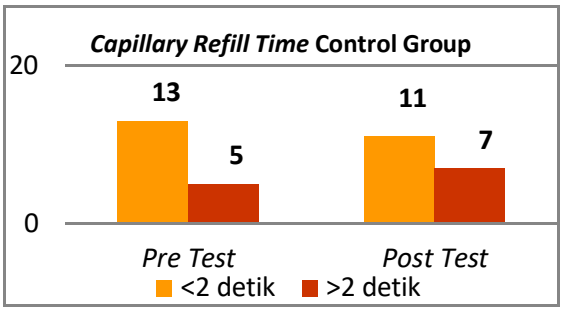


**Diagram 4. *Capillary Refill Time* Values *Pretest-Posttest* Control Group**

Based on diagram 4, the capillary refill time value in the control group, which was not given any pretest intervention, was 13 people with normal CRT <2 seconds. Meanwhile, the *posttest* results showed that 11 people had normal CRT, namely <2 seconds.

**Table 2. Results of the Wilcoxon Signed Ranks Test: Diabetic Neuropathy *Pretest-Posttest* Treatment Group and Control Group.**

| Information | N | Mean | Sig *2-tailed* |
|---|---|---|---|
| Treatment Group Pre-test | | 2.33 | |
| Treatment Group Post-test | 36 | 1.42 | 0.012 |
| Control Group Pre-test | | 2.22 | |
| Control Group Post-test | 36 | 2.39 | 0.257 |

Based on the results in Table 2, it can be concluded that the results of the Wilcoxon Signed Ranks Test Pretest-Posttest t for the treatment group showed a p value = 0.012, which means there is an effect of diabetic foot exercises using plastic balls on diabetic neuropathy. Meanwhile, the pretest-posttest for the control group showed a p-value = 0.257, which means there was no effect because no intervention was carried out in the control group.

**Table 3. Results of the Wilcoxon Signed Ranks Test: *Capillary Refill Time Pretest-Posttest* Treatment Group and Control Group**

| Information | N | Mean | Sig *2-tailed* |
|---|---|---|---|
| Treatment Group Pre-test | | 1.50 | |
| Treatment Group Post-test | 36 | 1.28 | 0.046 |
| Control Group Pre-test | | 1.28 | |
| Control Group Post-test | 36 | 1.39 | 0.317 |

Based on the results in Table 3, it can be concluded that the results of the Wilcoxon Signed Ranks Test pretest-posttest t for the treatment group showed a p value = 0.046, which means there is an influence of diabetic foot exercises using plastic balls on *capillary refill time.* Meanwhile, *the pretest-posttest for the control group showed a p-value* = 0.317, which means there was no effect because no intervention was carried out in the control group.

## DISCUSSION

Peripheral neuropathy occurs due to uncontrolled increases in blood glucose levels, leading to peripheral nerve damage. This condition causes foot problems in people with diabetes mellitus (DM), who often experience tingling, numbness, a sensation of thickness, and gait imbalance—symptoms that generally affect the lower extremities (Tofure, I. R., Huwae, L. B., Astuty, 2021).

Several factors contribute significantly to the occurrence of neuropathy in individuals with DM. These include age, as physiological functions in the body decline with increasing age; and gender, where hormonal differences—particularly estrogen and progesterone in women—can influence cellular responses to insulin (Mildawati, M., Diani, N, Wahid, 2019). Additionally, a longer duration of diabetes increases the risk of neuropathy complications because prolonged hyperglycemia leads to the accumulation of glucose, which can damage peripheral nerves (Hikmat Permana, 2016).

Individuals with DM often experience a prolonged capillary refill time (CRT) of more than 2 seconds. This is usually accompanied by decreased peripheral pulse rate, pale skin color in the lower extremities, and cold acral skin, which are signs of ischemia (Susannah Fleming, Peter J Gill, Ann Van den Bruel, 2016). CRT is a quick and simple test conducted by pressing the tip of the nail or thumb until blanching occurs, then observing the time it takes for normal color to return. This is used to assess peripheral blood circulation (Heru Purnomo, Mu'awanah, M.Nor Mudhofar, Ajeng T Normawati, 2020).

A study by (Oktaviah, D., Hasneli, 2014) demonstrated the effectiveness of diabetic foot exercises using plastic balls in improving foot sensitivity in patients with Type 2 DM. Their results showed a significant improvement in the experimental group after the intervention, with a p-value of 0.000 (<0.05). Similarly (Simamora, F. A., Siregar, H. R.,Hidayah, 2020), found a reduction in neuropathy scores following the implementation of diabetic foot exercises. These findings are consistent with (Taufan Arif, 2018) who reported a significant improvement in CRT in both the treatment and control groups after diabetic foot exercises, indicating the intervention's influence on peripheral perfusion (Siska Pindi Triani, Anik Enikmawati, 2022).

According to (Soebagijo Adi Soelistijo, Ketut Suastika, Dharma Lindarto, Eva Decroli, Hikmat Permana, 2021) ommended form of physical activity for DM patients is foot exercise, which involves movements of the muscles and joints in the feet (Maelina Ariyanti, Hapipah, Heri Bahtiar, 2019). Foot exercises are beneficial for preventing diabetic ulcers, strengthening foot muscles, preventing deformities, and improving blood circulation in the feet (Riska Kurnia Pratiwi, 2022).

Neuropathy symptoms typically begin in the big toe and gradually spread to the soles and eventually the entire foot. Initial symptoms include paresthesia—such as tingling, burning sensations, and pain—especially at night or during rest. As the condition progresses, patients often experience reduced tactile sensitivity (numbness) and diminished balance while walking. Therefore, lifestyle modifications and physical interventions such as diabetic foot exercises using plastic balls offer non-pharmacological alternatives to slow the progression of neuropathy and enhance vascularization in the feet (Yunita Carolina Satti, Fransisco Irwandy, Federiko Woda Sado, 2024).

Diabetic foot exercises using plastic balls directly improve blood circulation in the lower extremities. The ball movements—rolling forward and backward and gripping the ball with the feet—stimulate nerves located in the soles, which are connected to the pancreas, potentially supporting insulin regulation and glucose control (Ratanto, n.d.).

In addition, this intervention enhances vasodilation, thereby improving blood flow in the feet. As a result, neuropathy symptoms decrease, peripheral pulses become stronger, and capillary refill time returns to normal (<2 seconds), indicating improved peripheral perfusion (Suarniati St, Fitria Hasanuddin, 2021).

## CONCLUSIONS

Based on the results of the analysis and discussion, it can be concluded that the average degree of diabetic neuropathy in both the treatment group (prior to the intervention) and the control group (without intervention) was categorized as moderate. The average capillary refill time (CRT) before the intervention was >2 seconds in the treatment group and <2 seconds in the control group.

After the intervention, the treatment group showed an improvement in the degree of diabetic neuropathy, which shifted to the mild category, while the control group remained in the moderate

category. In terms of CRT, the post-intervention results in the treatment group improved to <2 seconds, indicating normal peripheral perfusion. The CRT in the control group remained <2 seconds.

These findings demonstrate that diabetic foot exercises using a plastic ball as a non-pharmacological intervention had a significant positive effect on reducing the severity of diabetic neuropathy and improving capillary refill time. It is recommended that this intervention be routinely introduced and supported by health centers and practiced independently by people with diabetes to help prevent the progression of neuropathy complications.

## REFERENCES


Hasina, S. N., Shodiq, M., Ikwan, M., Putri, R. A., Noventi, I., & Masithah, D. (2022). Pengaruh Edukasi Kesehatan Terapi Buerger Allen Exercise Terhadap Pengetahuan Penderita Diabetes Mellitus Dalam Upaya Menurunkan Resiko Gangguan Perfusi Jaringan Perifer. *Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal*, *12*(4), 871–876. http://repository.unusa.ac.id/9097/20/Pengaruh Edukasi Kesehatan Terapi Buerger Allen Exercise Terhadap Pengetahuan Penderita Diabetes Mellitus Dalam Upaya Menurunkan Resiko Gangguan Perfusi Jaringan Perifer.pdf

Heru Purnomo, Mu'awanah, M.Nor Mudhofar, Ajeng T Normawati, L. S. (2020). Pengaruh Latihan Peregangan Kaki Terhadap Pengisian Kapiler Pada Penderita Luka Ulkus Diabetes. *Jurnal Studi Keperawatan*, *1*(2), 17–22. https://download.garuda.kemdikbud.go.id/article.php?article=3049369&val=27726&title=Pengaruh Latihan Peregangan Kaki Terhadap Pengisian Kapiler Pada Penderita Luka Ulkus Diabetes

Hikmat Permana. (2016). Komplikasi Kronik dan Penyakit Penyerta Pada Diabetesi. *Jurnal Ilmiah. Division of Endocrinology and Metabolism Department of Internal MedicinePadjadjaran University Medical School. Hasan Sadikin Hospital. Bandung*. https://adoc.pub/komplikasi-kronik-dan-penyakit-penyerta-pada-diabetesi.html

Maelina Ariyanti, Hapipah, Heri Bahtiar, R. A. (2019). Pengaruh Senam Kaki Diabetes Dengan Bola Plastik Terhadap Perubahan Kadar Gula Darah Pada Pasien Diabetes Mellitus Tipe 2. *Jurnal CARING (Center of Research Publication in Midwifery and Nursing)*. https://core.ac.uk/outputs/352145568/?utm_source=pdf&utm_medium=banner&utm_campaign=pdf-decoration-v1

Mardastuti, Y., Asmedi, A., Gofir, A. (2016). Diabetic neuropathy symptom-versi Indonesia dan diabetic neuropathy examination-versi Indonesia sebagai skor diagnostik. *Berkala Neurosains*, *15*(2), 55–65. https://journal.ugm.ac.id/bns/article/view/55750

Mildawati, M., Diani, N, Wahid, A. (2019). Hubungan usia, jenis kelamin dan lama menderita diabetes dengan kejadian neuropati perifer diabetic. *CNJ: Caring Nursing Journal*, *3*(2), 30–37. https://download.garuda.kemdikbud.go.id/article.php?article=1220877&val=10400&title=Hubun

Oktaviah, D., Hasneli, Y. (2014). Efektifitas senam kaki diabetik dengan bola plastik terhadap tingkat sensitivitas kaki pada pasien diabetes melitus tipe 2. *J Urnal Online Mahasiswa Program Studi Ilmu Keperawatan Universitas Riau*. https://www.neliti.com/publications/186150/efektifitas-senam-kaki-diabetik-dengan-bola-plastik-terhadap-tingkat-sensitivita

Ratanto, D. S. (n.d.). Pengaruh Senam Diabetik Dengan Bola Tenis Terhadap Tingkat Sensitivitas Kaki Pasien Dm Tipe II. *Mahakam Nursing Journal*, *2*(5). https://ejournalperawat.poltekkes-kaltim.ac.id/ojs/index.php/nursing/article/view/148

Riska Kurnia Pratiwi. (2022). *Pengaruh Senam Kaki Diabetic Terhadap Neuropathy Diabeticum Pada Penderita Diabetes Mellitus*. https://repository.uds.ac.id/423/

Saputri, S., Minarningtyas, A., Puspitasari, I. (2023). Penerapan Buerger Allen Exercise terhadap Nilai Capillary Refill Time (CRT) pada Klien Diabetes Melitus Tipe 2. *Jurnal Gema Keperawatan*, *16*(1), 99–110. https://ejournal.poltekkes-denpasar.ac.id/index.php/JGK/article/view/2411

Setianingrum. (2020). *Pengembangan Protokol Intervensi Senam Kaki Diabetik Terhadap Tingkat Sensitifitas Kaki Pada Pasien Diabetes Melitus Tipe 2*.

Simamora, F. A., Siregar, H. R.,Hidayah, A. (2020). Pengaruh Senam Kaki Diabetik terhadap penurunan neuropati pada penderita diabetes melitus tipe 2. *Jurnal Education and Development*,

*8*(4), 431–431. https://journal.ipts.ac.id/index.php/ED/article/view/2164

Siska Pindi Triani, Anik Enikmawati, Y. W. (2022). Pengaruh Senam Kaki Diabetes Terhadap Sensitivitas Kaki Pasien Diabetes Mellitus. *Jurnal Rumpun Ilmu Kesehatan*, *2*(2). https://ejurnal.politeknikpratama.ac.id/index.php/JRIK/article/view/739

Soebagijo Adi Soelistijo, Ketut Suastika, Dharma Lindarto, Eva Decroli, Hikmat Permana, K. W. sucinto. (2021). *Pedoman Pengelolaan dan Pencegahan Diabetes Mellitus Tipe 2 di Indonesia*. PB Perkeni. https://pbperkeni.or.id/wp-content/uploads/2021/11/22-10-21-Website-Pedoman-Pengelolaan-dan-Pencegahan-DMT2-Ebook.pdf

Suarniati St, Fitria Hasanuddin, N. (2021). Penerapan Senam Kaki Pada Pasien Diabetes Melitus. *Alauddin Scientific Journal of Nursing*, *2*(1). https://arsip-journal.uin-alauddin.ac.id/index.php/asjn/article/view/20190

Susannah Fleming, Peter J Gill, Ann Van den Bruel, M. T. (2016). Capillary refill time in sick children: a clinical guide for general practice. *British Journal of General Practice, 66*(652), 587–588. https://pmc.ncbi.nlm.nih.gov/articles/PMC5072914/

Taufan Arif. (2018). Pengaruh Senam Kaki Diabetesterhadapcapilary Refill Time Periferklien Diabetes Mellitus Di Puskesmas Dinoyo Malang. *Jurnal Keperawatan Terapan*, *4*(2), 74–82. https://ojs.poltekkes-malang.ac.id/index.php/JKT/article/view/302

Tofure, I. R., Huwae, L. B., Astuty, E. (2021). No Title. *Molucca Medica*, *14*(2), 97–108. https://ojs3.unpatti.ac.id/index.php/moluccamedica/article/view/4380

Yasa, I. D. P. G. P. (2019). Nilai Ankle Brachial Index (ABI) Dengan Neuropati Perifer Diabetik Pada Pasien Diabetes Melitus Tipe 2. *Jurnal Gema Keperawatan*. https://ejournal.poltekkes-denpasar.ac.id/index.php/JGK/article/view/818

Yunita Carolina Satti, Fransisco Irwandy, Federiko Woda Sado, M. G. (2024). Evaluation of Video Based Foot Exercise on Increasing Foot Sensitivity in Neuropathy Diabetes. *Jurnal Keperawatan Florence Nightingale*, *7*(1). https://www.ejournal.stikstellamarismks.ac.id/index.php/JKFN/article/view/144