Int J Adv Life Sci Res. Volume 7(2) 9-16
https://doi.org/10.31632/ijalsr.2024.v07i02.002

International Journal of Advancement in Life Sciences Research

Online ISSN: 2581-4877

Journal. homepage http://ijalsr.org

Review Article

Successful Aspects and Impacts of Diabetic Foot Exercise Among Indonesian Type 2 Diabetes Mellitus Patients: A Literature Review

Healthy Seventina Sirait [1,2]*, Faridah Mohd Said[1], Nur Afiqah Mohamad[3]

[1]*Faculty of Nursing, Lincoln University College, Wisma Lincoln, 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor, Malaysia*
[2]*STIKes Cirebon, Kabupaten Cirebon, Jawa Barat 45153, Indonesia*
[3]*Centre for Foundation Studies, Lincoln University College, Wisma Lincoln, 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor, Malaysia.*

**Correspondence E-mail: healthy.seventinasirait@gmail.com*

Abstract

Backgrounds: Prevalence of diabetic foot among patient remains high worldwide, including in Indonesia. Foot exercise becomes one solution to prevent this health issue. However, the procedure seems simple but many factors influence the successful of this intervention. Numerous studies had been published related to the successful aspects and the outcomes of diabetic foot exercise but those are still dispersed. So that, the comprehensive information of diabetic foot exercise is still puzzled and do not utilize maximally by clinicians. **Purposes**: This study aims to review and synthesis previous information related to successful aspects and impacts of diabetic foot exercise among Indonesian Type 2 Diabetes Mellitus patients. The present comprehensive review compile and synthesize the information on diabetic foot exercise, which can serve as a source for future studies or be utilized for clinical practices. **Methods**: A literature review had been chosen in this study with PRISMA approach to sort the articles from EBSCOHost, Google Scholar, Science Direct, Wiley Online and ProQuest. We used a Mixed Method Appraisal Tool to determine the eligibility of articles that included to this study. **Results**: We harvested 1,481 articles and synthesized 20 selected articles. Our findings revealed intrinsic and extrinsic aspects of diabetic foot exercise were the key to improve the intervention's outcome. Most outcomes of diabetic foot exercise were related to physical benefits. Although, mental benefits also captured in this study. Interestingly, our review found a unique finding, which in the Indonesia context, the spiritual outcome was also mentioned by diabetic patients after received diabetic foot exercise. **Conclusion**: By deliberate our findings, clinicians may scale up and aware the supporting aspects of diabetic foot exercise when providing this therapy to diabetes mellitus patients. Thus, the patients may achieve the highest benefit of diabetic foot exercise.

Keywords:- *Diabetic foot exercise, Successful aspects, Type 2 Diabetes Mellitus.*

Introduction

Diabetes mellitus remains a global health concern as it ranks among the top 10 non-communicable diseases and is considered a catastrophic illness that can disrupt the national healthcare system if not well managed. This becomes a serious problem for public health because diabetes mellitus is constantly growing over years. In 2021, the prevalence of diabetes mellitus reached 10.5% of global population and it is projected will reach 12,2% globally in 2024 (Sun *et al*., 2022). Diabetes mellitus is a disorder originating from pancreatic dysfunction, especially in type 2 diabetes where insulin production is inadequate. Previous studies and data from the World Health Organization (WHO) indicate that type 2 diabetes mellitus leads to complications that can adversely affect public health, such as retinopathy, foot ulceration, cardiovascular diseases, hypertension, and more (WHO, 2023). Foot ulceration in diabetic patients is a common occurrence due to poor diabetes foot care

Received on :11th Jnauary2024; Revised version received on :25th March 2024; Accepted: 1st April 2024

management, resulting in wounds, infections, or the decline in physiological foot function, leading to various foot disorders (Gamboa-Antiñolo, 2023).

Epidemiologically, foot disorders in diabetic patients reach a significant number, with numbers 8% to 52.0% occurrence in diabetic population, raising concerns among healthcare professionals to prevent such incidents by providing optimal promotive and preventive services (Gamboa-Antiñolo, 2023). However, the quality of healthcare services often faces challenges, and the intended goals may not be fully achieved (Marwati *et al*., 2022). One of the current practices is diabetic foot exercises for patients. Diabetic foot exercises consist of guided movements aimed at improving blood circulation in the peripheral areas of the feet, thereby minimizing foot complications. Patients can perform these exercises independently or under the guidance of healthcare professionals, such as nurses, if needed. Although the therapy seems simple, there are many factors to consider to achieve optimal results (Francia *et al.*, 2014).

However, diabetic foot exercises are sometimes overlooked as a therapy, both by patients and healthcare professionals, as patient care tends to focus more on low-sugar diets, pharmacological treatments, and other perceived complex therapies. This issue is further exacerbated in primary healthcare facilities in Indonesia, where education on diabetic foot exercises is rarely provided due to the overwhelming responsibilities of healthcare professionals in the community and the overlap with other healthcare programs (Nasir *et al.*, 2023; Ligita *et al.*, 2019).

It is mentioned that there are many factors that influence diabetic foot exercises (Matos *et al.*, 2018). The complexity of this therapy is often unknown to nurses as they tend to focus solely on the patient or the therapy itself. However, there are external factors that determine the success of diabetic foot exercises and interventions for patients with diabetes mellitus. A study conducted by Francia *et al.* (2015) demonstrates that these factors play a crucial role in the effectiveness of diabetic foot exercises. Therefore, it is important to understand what needs to be considered when providing diabetic foot exercise therapy.

The aim of this study is to identify the factors that influence diabetic foot exercise therapy and the possible outcomes that can be achieved. This will provide concrete scientific evidence for clinicians to implement this therapy for their patients.

Material and Methods

This research conducted a literature review by searching reputable health research databases such as EBSCOHost, Google Scholar, ScienceDirect, Wiley Online, and ProQuest. The PICO approach was utilized to formulate a research question that aligns with the study's objectives.

To search for articles in targeted journal databases, relevant keywords were chosen, including combinations such as "Diabetic foot exercise OR senam kaki diabetes," "diabetes mellitus OR DM OR T2DM," and "Factor OR outcomes." The selection of articles was based on predetermined inclusion and exclusion criteria. These criteria focused on articles that addressed diabetic foot exercise or diabetic foot care management in adult populations, were published in English between 2019 and 2023. We excluded Pilot studies, feasibility studies, and literature review studies. Articles with a lower standard score on the Mixed Method Appraisal Tool (MMAT) were also excluded. A threshold score of 80 was used to determine whether an article passed the critical appraisal using MMAT (Hong, 2021; Hong *et al.*, 2018a; Hong *et al.*, 2018b)

Eligible articles were carefully read, and their findings were recorded in a table. The results were then summarized and presented to facilitate understanding of the synthesis results, following the typology of literature review research (Grant & Booth, 2009; Nursalam, 2020). The screening and article identification process adhered to the PRISMA framework, ensuring a structured and systematic approach (Page *et al*., 2021).

Results and Discussion:

After conducting a thorough search on the specified databases, a total of 1,481 articles were initially identified that met the inclusion criteria. To ensure the quality and relevance of the articles, a screening process was carried out, involving the elimination of duplicate articles and the evaluation of titles, abstracts, and content. Through this rigorous screening, only the eligible articles were selected for further analysis. The article selection and screening process, following the PRISMA flow diagram as determined by the researchers, is illustrated in Figure 1.

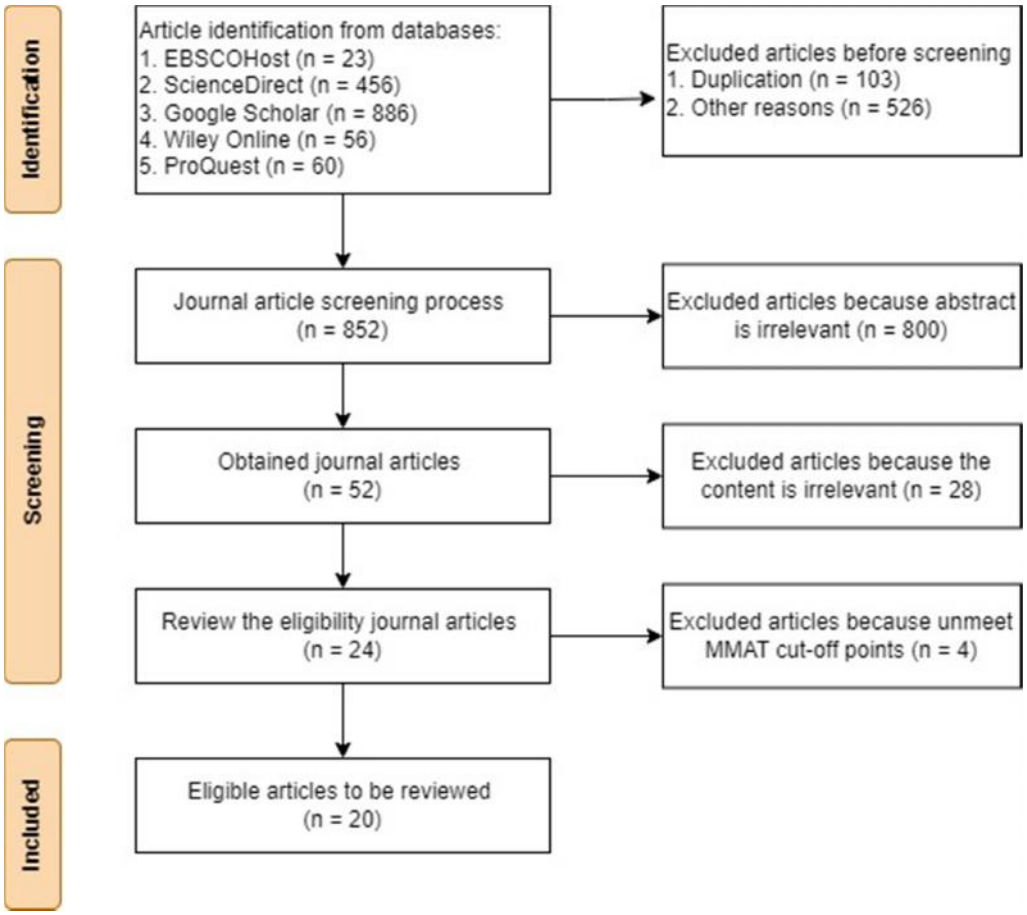

Figure 1. The article selection and screening process PRISMA flow diagram

After the screening procedure, it was established that a total of 20 articles met the predetermined criteria set by the research team. These chosen articles underwent a comprehensive evaluation using MMAT, and the findings from this assessment are presented in Table 1, as depicted below.

Authors	**Year of Published**	**Study Design**	**MMAT Score**
Sari *et al.*	2022a	Qualitative	100
Yusnita *et al.*	2020	Quasi-experiment	100
Handayani *et al.*	2020	Quantitative	100
Kristianto	2023	Quantitative	80
Sari *et al.*	2022b	Quasi-experiment	80
Nurhayati	2022	Quasi-experiment	100
Sukartini *et al.*	2020	Quasi-experiment	100
Graciella and Prabawati	2020	Quasi-experiment	80
Widyaningsih *et al.*	2022	Pre-experimental	100
Monteiro *et al.*	2022	Quantitative	80
Parellangi *et al.*	2022	Pre-experimental	80
Fadillah, Sucipto and Rahil	2019	Quasi-experiment	100
Simamora *et al.*	2023	Quasi-experiment	80
Pasaribu and Sebayang	2020	Quasi-experiment	80
Oktavianti and Hernawati	2022	Quantitative	80
Syaipuddin *et al.*	2023	Pre-experimental	80
Simbolon	2020	Quasi-experiment	80
Sanjaya, Yanti and Puspita	2019	Quasi-experiment	80
Purwaningsih, Ludiana and Immawati	2023	Quantitative	80
Isworo *et al.*	2021	Qualitative	80

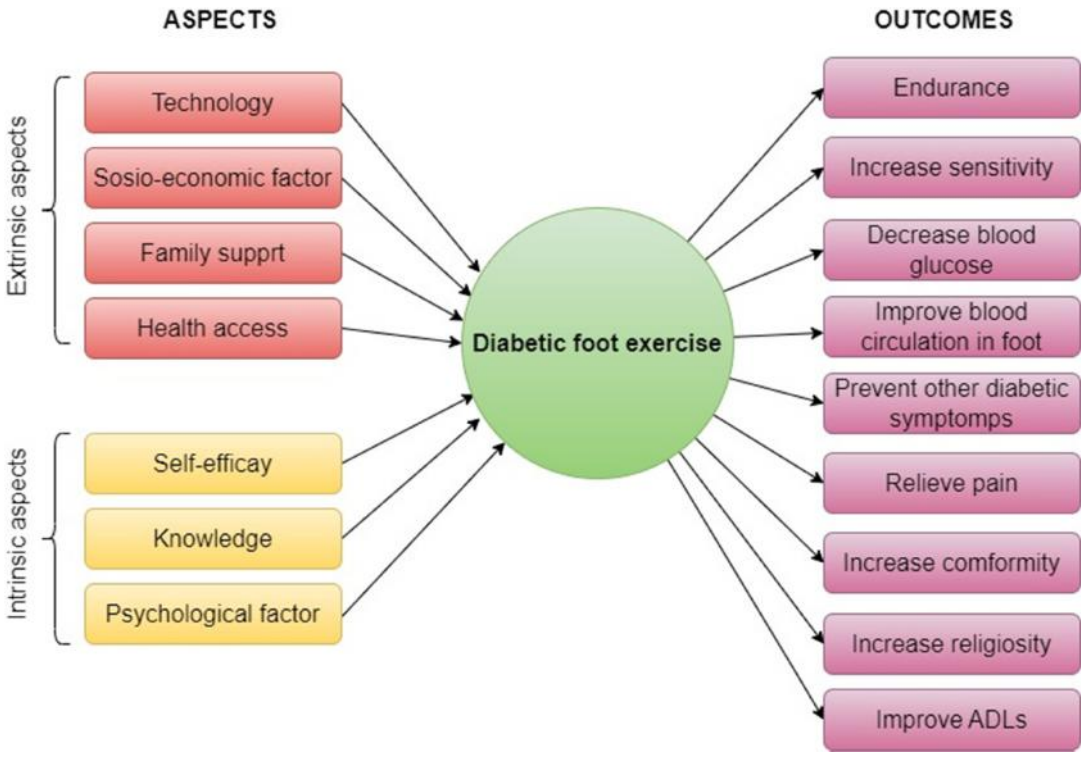

Figure 2. Relationship with extrinsic and intrinsic aspects of diabetes foot care with outcomes

Factors affecting Diabetic Foot Exercises

There are intrinsic and extrinsic factors that influence the ability of patients, with intrinsic factors referring to factors within the patients themselves and extrinsic factors being external to the patients (Figure 2). Isworo *et al*. (2021) identified several factors such as limited resources, a busy schedule, and financial constraints as determinants of optimal care for patients with diabetes mellitus. Self-care practices, such as foot care and diabetes foot exercises, are poorly implemented among individuals with diabetes. Poor family support, low education, and poor socioeconomic status are likely the main reasons behind inadequate self-care practices at the individual level (Handayani *et al*., 2020). Self-care practices in diabetes foot management, such as exercises, are essential skills as patients are not monitored by healthcare providers 24/7, making patient empowerment a primary goal of care. The need for education to teach and support diabetes patients in self-care practices through flagship diabetes management programs is currently lacking. Building self-efficacy in patients is crucial for patient empowerment. Independence in performing self-care, including diabetes foot exercises, will improve patient recovery (Sari *et al*., 2022a).

Health education plays a significant role in supporting patient care, including in patients with diabetes mellitus (Oktavianti & Hernawati, 2022; Yusnita *et al*., 2020). The transition of diabetes mellitus patients to their condition requires assistance from healthcare providers to understand what can and cannot be done by the patients. Health education regarding self-management of diabetes mellitus, including diabetes foot exercises, serves as a catalyst for the health outcomes of patients with diabetes mellitus. This is also evident in Gagliardino *et al.* (2019) research, which showed a nearly 20-point difference in the ability of diabetes mellitus patients to care for themselves after receiving education compared to those who did not receive education.

Sari *et al.* (2022b) in their study describes four main themes: personal barriers, environmental barriers, perceived foot health benefits, and religious practices. Sub-themes under personal barriers include low susceptibility to foot ulcers, limited knowledge about foot care, fatalistic practices, financial problems, prioritizing glucose control over foot care, lack of motivation, lack of confidence, and fear of

being labeled. Sub-themes under environmental barriers encompass lack of knowledge and time among healthcare providers, lack of family support, and climate conditions. Sub-themes under perceived foot health benefits include the intention to feel better and the desire to remain socially active. Sub-themes under religious practices include foot washing as part of religious rituals and the intention to be clean before praying.

Several factors influence this context, where personal barriers are the primary obstacles that patients need to overcome to achieve optimal diabetes foot exercise. This is evident from the multitude of factors that emerged. Internal motivation alone is not enough; it must be balanced with adequate financial capacity to access foot care. Disparities in the care of diabetes mellitus patients are found across various dimensions of known socioeconomic factors such as income, education, occupation, and barriers reported by patients in accessing healthcare services. Healthcare gaps are also associated with lower quality of care, with patients experiencing larger gaps more likely to face difficulties in key self-care aspects. The study also concludes that even in a healthcare system with universal coverage, healthcare inequalities can arise, starting from preventive care (Handayani *et al*., 2020).Family empowerment is one of the factors that support the success and optimal effects of diabetes foot exercises. Families provide a supportive environment that assists patients in performing diabetes foot exercises. One positive impact of these exercises is to enhance the resilience of patients (Parellangi *et al*., 2022).

Telehealth has emerged as a solution to address these challenges. Telehealth has the potential to become a practical and time-saving option for patients, their families, and healthcare professionals, including nurses, when physical proximity is not essential. This innovative approach, if implemented intelligently and attentively, can improve diabetes management in a clinically relevant manner and reduce undesirable clinical outcomes. In relation to diabetes foot exercise, the use of telehealth can have implications for routine monitoring without the need to visit healthcare facilities, providing greater convenience for patients. There are no age or clinical condition limitations for patients to utilize telehealth approaches, as even older and frail patients have been shown to benefit from remote consultations. The challenge faced by the National Health Service is to ensure that telehealth becomes a well-structured, optimized, and properly coded care pathway, capable of fully integrating as a complementary/hybrid assistance modality for diabetes management (Kristianto, 2023). Bose et al. (2021) described automated diabetic forecasting system to detect the condition at an early stage.

Outcomes of Diabetic Foot Exercises

Diabetes foot exercises have numerous benefits beyond the foot area for patients with diabetes mellitus. Some additional benefits include supporting the improvement of patients' daily activity levels and reducing blood glucose levels. In a study by Nurhayati (2022), positive changes were observed in both aspects, and statistically, they were attributed to diabetes foot exercises.

Foot exercises are a type of activity that patients with diabetes mellitus can do to avoid injury and improve blood circulation in their feet. These exercises aim to increase blood flow to the tissues, strengthen small muscles, calf muscles, and thigh muscles, and overcome joint motion limitations commonly experienced by people with diabetes mellitus (Simbolon, 2020). Consequently, it is expected that the feet of diabetic patients can be well-maintained, leading to an improvement in their quality of life. Physical activities such as foot exercises play a crucial role for individuals with physical ability problems, including fall risks, fall-related injuries, physical function, frailty, and osteoporosis. High-intensity exercise frequency is associated with activity and the risk of physical functional limitations in older adults. High-certainty evidence demonstrates that balance and functional exercises reduce the rate of falls and can help improve various elements of physical function (Nurhayati, 2022).

Patients with diabetes mellitus who engage in foot exercises will experience a decrease in peripheral sensory neuropathy because the foot exercise movements can improve the function of myelin nerves and axons, resulting in improved nerve conduction and sensitivity, which can be tested using a monofilament. The intervention group showed a decrease in sensory peripheral neuropathy, while the control group did not show a decrease in sensory peripheral neuropathy, supporting the

aforementioned theory that foot exercises can help improve blood circulation and sensitivity to prevent numbness (Purwaningsih *et al.*, 2023; Sanjaya *et al.*, 2019; Sukartini *et al.*, 2020).

Community health nurses can provide education about foot exercises to diabetes mellitus patients, especially those with peripheral neuropathy. Diabetes mellitus patients can independently perform foot exercises at home to improve their peripheral sensory neuropathy status and prevent the occurrence of ulcers. Health literacy plays an important role in this aspect (Kamillah *et al.* 2023). Graciella & Prabawati (2020) added that another benefit of diabetes foot exercises is the reduction of blood glucose levels for patients. Furthermore, regular foot exercises can alleviate symptoms of diabetes mellitus such as fatigue, tingling, pain, cramps, and numbness (Widyaningsih *et al.*, 2022).

Diabetes foot exercises can be a solution to improve the sensory sensitivity of the feet in patients with diabetes mellitus (Monteiro *et al.*, 2022). Diabetes foot exercises have the effect of improving blood circulation in the peripheral ends of the feet, thereby optimizing the blood supply to the foot nerves. This will enhance the sensitivity of the feet in patients with diabetes mellitus (Fadlilah *et al*., 2019). In patients with diabetes mellitus, the risk of atherosclerosis is higher. Physiological age affects changes in the condition of blood vessels associated with atherosclerosis. Atherosclerosis can obstruct blood flow, leading to tissue hypoxia that affects nerve cell function. Decreased nerve cell function can reduce sensation in the feet. Diabetes foot exercises that improve perfusion can reduce hypoxia and alleviate pain sensation in the feet of patients (Simamora *et al.*, 2023).

Diabetic foot exercise was also one of therapy that may improve blood glucose regulations. This proved by several studies that found blood glucose level gradually decreased after getting this exercise (Graciella & Prabawati, 2020; Haskas *et al.*, 2023). This better regulation of blood glucose then improve wound healing process among patients (Pasaribu & Sebayang, 2020) An interesting aspect of providing diabetes foot exercises is that they not only provide physical benefits but also offer psychological benefits related to comfort during religious rituals. They help patients become more independent in maintaining the cleanliness and functionality of their feet. This outcome is important as a reference for the actions taken by nurses in caring for patients with diabetes mellitus (Sari *et al*., 2022b).

Conclusion

In conclusion, diabetes foot exercises play a crucial role in improving the sensory sensitivity of the feet, enhancing blood circulation, reducing neuropathy, and lowering blood glucose levels in patients with diabetes mellitus. Various intrinsic and extrinsic factors influence the implementation of foot exercises, including personal barriers, environmental barriers, perceived foot health benefits, and religious practices. Overcoming personal barriers, such as limited knowledge, financial constraints, and lack of motivation, is essential for patients to engage in effective self-care practices. Health education and telehealth can provide support and guidance to patients in performing foot exercises and managing their diabetes. Additionally, diabetes foot exercises not only have physical benefits but also contribute to psychological well-being and independence in daily activities. The integration of diabetes foot exercises into patient care can lead to improved outcomes and enhance the overall quality of life for individuals with diabetes mellitus.

Acknowledgement

Authors are thankful to the management of STIKes Cirebon, Indonesia and Lincoln University College, Malaysia, for academic support.

Conflict of Interest:

The authors declare that they have no conflict of interest.

References

Bose, P., Bandyopadhyay, S. K., Bhaumik, A., & Poddar, S. (2021). Female Diabetic Prediction in India Using Different Learning Algorithms. Universal Journal of Public Health 9(6): 460-471. 10.13189/ujph.2021.090614

Fadlilah, S., Sucipto, A., & Rahil, N. H. (2019). Effectiveness of Diabetic Foot Exercises Using Sponges and Newspapers on Foot Sensitivity in Patients with Diabetes Mellitus. *Belitung Nursing Journal.*, *5*(6), 234-238. https://doi.org/10.33546/bnj.822

Francia, P., Anichini, R., De Bellis, A., Seghieri, G., Lazzeri, R., Paternostro, F., & Gulisano, M. (2015). Diabetic foot prevention: the role of exercise therapy in the treatment of limited joint mobility, muscle weakness and reduced gait speed. *Ital.ian journal. of anatomy and embryology*, *120*(1), 21-32. https://doi.org/10.13128/IJAE-16470

Francia, P., Gulisano, M., Anichini, R., & Seghieri, G. (2014). Diabetic foot and exercise therapy: step by step the role of rigid posture and biomechanics treatment. *Current diabetes reviews*, *10*(2), 86-99. https://doi.org/10.2174/1573399810666140507112536

Gagliardino, J. J., Chantelot, J. M., Domenger, C., Ramachandran, A., Kaddaha, G., Mbanya, J. C., ... & IDMPS Steering Committee. (2019). Impact of diabetes education and self-management on the quality of care for people with type 1 diabetes mellitus in the Middle East (the International Diabetes Mellitus Practices Study, IDMPS). *Diabetes research and clinical. practice*, *147*, 29-36. https://doi.org/10.1016/j.diabres.2018.09.008

Gamboa-Antiñolo, F. M. (2023). Diabetic foot ulcers: a growing global health emergency in the COVID-19 era. *Internal. and Emergency Medicine*, *18*(5), 1259-1261. https://doi.org/10.1007/s11739-023-03217-8

Graciella, V., & Prabawati, D. (2020, November). The effectiveness of diabetic foot exercise to peripheral neuropathy symptoms and fasting blood glucose in type 2 diabetes patients. In *International. Conference of Heal.th Development. Covid-19 and the Role of Heal.thcare Workers in the Industrial. Era (ICHD 2020)* (pp. 45-49). Atlantis Press. https://doi.org/10.2991/ahsr.k.201125.008

Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Heal.th information & libraries journal.*, *26*(2), 91-108. https://doi.org/10.1111/j.1471-1842.2009.00848.x

Handayani, O. W., Nugroho, E., & Hermawati, B. (2020). Determinant of diabetes mellitus focusing on differences of Indonesian culture: Case studies in the Java and outer java region in Indonesia. *The Open Public Heal.th Journal.*, *13*(1), 323-340. https://doi.org/10.2174/1874944502013010323

Hong, Q. N. (2021). Questions on the MMAT version 2018.

Hong, Q. N., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., ... & Pluye, P. (2018a). The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for information*, *34*(4), 285-291. https://doi.org/10.3233/EFI-180221

Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., ... & VEDEL, I. (2020b). Mixed methods appraisal tool (MMAT) version française 2018. *Education for Information*. http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf%0Ahttp://mixedmethodsappraisaltoolpublic.pbworks.com/

Isworo, A., Sari, Y., Sumeru, A., & Nuriya, N. (2021). Barriers in Diabetes Self-management: A Qualitative Study from the Perspective of Nurses in Primary Health Centers, Indonesia. *Open Access Macedonian Journal. of Medical. Sciences*, *9*(E), 1345-1352. https://doi.org/10.3889/oamjms.2021.7451

Kamillah, S., Panduragan, S. L., Poddar, S., & Bhaumik, A. (2023). Improving Diabetes Condition Through Health Literacy: A Case Study From Cianjur, West Java, Indonesia. *Malaysian Journal of Medicine & Health Sciences*, 19(Supp9): 221-229. https://doi.org/10.47836/mjmhs.19.s9.31

Kristianto, H. (2023). Analysis of risk factors responsible for neuropathy in patients with type 2 diabetes mellitus with diabetic foot during the COVID-19 pandemic. *Iranian Journal. of Nursing and Midwifery Research*, *28*(1), 85-91. https://doi.org/10.4103/ijnmr.ijnmr_180_21

Ligita, T., Wicking, K., Francis, K., Harvey, N., & Nurjannah, I. (2019). How people living with diabetes in Indonesia learn about their disease: A grounded theory study. *PloS one*, *14*(2), e0212019. https://doi.org/10.1371/journal.pone.0212019

Marwati, T. A., Kusmayanti, N. A., & Rosyidah, R. (2022). Quality of Life Among Diabetes Mellitus Patients in Indonesian Chronic Disease Management Program (Prolanis). *Epidemiology and Society Health Review (ESHR)*, *4*(2), 76-86. https://doi.org/10.26555/eshr.v4i2.5341

Matos, M., Mendes, R., Silva, A. B., & Sousa, N. (2018). Physical activity and exercise on diabetic foot related outcomes: a systematic review. *Diabetes Research and Clinical Practice*, *139*, 81-90. https://doi.org/10.1016/j.diabres.2018.02.020

Monteiro, R. L., Ferreira, J. S., Silva, É. Q., Cruvinel-Júnior, R. H., Veríssimo, J. L., Bus, S. A., & Sacco, I. C. (2022). Foot–ankle therapeutic exercise program can improve gait speed in people with diabetic neuropathy: A randomized controlled trial. *Scientific reports*, *12*(1), 1-12. https://doi.org/10.1038/s41598-022-11745-0

Nasir, W. A., Palutturi, S., Arifin, A., Daud, A., & Mallongi, A. (2023). Analysis of Policy Implementation of Minimum Service Standards for Hypertension in Marusu Health Center Maros District. *Pharmacognosy Journal*, *15*(5). https://doi.org/10.5530/pj.2023.15.165

Nurhayati, N. (2022). The Effect of Foot Exercise on Daily Activities and Blood Sugar Levels of Elderly in South Bangka, Indonesia. *Journal of Drug Delivery and Therapeutics*, *12*(2-S), 58-62. https://doi.org/10.22270/jddt.v12i2-S.5421

Nursalam, H. (2020). Penulisan Literature Review dan Systematic Review Pada Pendidikan Kesehatan (Contoh). *Surabaya: Fakultas Keperawatan Universitas Airlangga*.

Oktavianti, D. S., & Hernawati, Y. (2022). Edukasi Senam Kaki Diabetik Sebagai Upaya Pencegahan Diabetic Foot Pada Pasien Diabetes Melitus. *Journal Community Service of Health Science*, *1*(1), 26-29. https://doi.org/10.58730/jcshs.v1i1.36

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Bmj*, *372*. https://doi.org/10.1136/bmj.n71

Parellangi, P., Wahyuni, E. P., Mustofa, K., Seda, B., & Tini, T. (2022). Endurance diabetes foot exercise based on family centered care (EDFE-BFCC) to reduce blood sugar levels patients diabetes mellitus type 2. *Health Notions*, *6*(2), 51-54. https://doi.org/10.33846/hn60201

Pasaribu, D. A., & Sebayang, S. M. (2020). Pengaruh senam kaki terhadap penyembuhan luka diabetik pada pasien diabetes mellitus di ruang rawat inap ra1 dan ra2 penyakit dalam rsup. H. Adam malik medan. *Indonesian Trust Health Journal*, *3*(1), 265-271. https://doi.org/10.37104/ithj.v3i1.45

Puwaningsih, E., Ludiana, L., & Immawati, I. (2023). Penerapan senam kaki diabetes untuk meningkatkan sensitivitas kaki pasien diabetes mellitus tipe ii di puskesmas metro. *Jurnal Cendikia Muda*, *3*(2), 235-244.

Sanjaya, P. B., Yanti, N. L. P. E., & Puspita, L. M. (2019). Pengaruh senam kaki diabetik terhadap sensitivitas kaki pada pasien dm tipe 2. *Community of Publishing in Nursing (COPING)*, *7*(2), 97-102.

Sari, C. W. M., Witdiawati, W., Purnama, D., Kurniawan, T., & Santoso, M. B. (2022a). Effect of Integrated Care Programs on Self-Efficacy and Self-Management Behaviors among Diabetic in a Primary Health Care in Indonesia. *Malaysian Journal of Medicine and Health Sciences*, *18*(Supp3): 157–161.

Sari, Y., Yusuf, S., Haryano, Sumeru, A., & Saryono. (2022b). The barriers and facilitators of foot care practices in diabetic patients in Indonesia: A qualitative study. *Nursing Open, 9*(6), 2867–2877. https://doi.org/10.1002/nop2.993

Simamora, F. A., Antoni, A., & Ritonga, S. H. (2023). Effectiveness of Diabetic Foot Exercise on Foot Pain Level in Diabetic Patients. *In Proceedings of the Tapanuli International Health Conference 2022 (TIHC 2022). Atlantis Press International BV*, *1* 54-59 https://doi.org/10.2991/978-94-6463-032-9

Simbolon, S. M. (2020). Faktor-Faktor Yang Memengaruhi Senam Kaki Terhadap Sirkulasi Darah Kaki Pada Pasien Diabetes Mellitus Di Ruang Penyakit Dalam RSUD Dr Pirngadi Medan 2018. *Dinamika Kesehatan: Jurnal Kebidanan Dan Keperawatan*, *11*(1), 310-318. https://doi.org/10.33859/dksm.v11i1.570

Sukartini, T., Panji Asmoro, C., & Nandani Alifah, P. (2019). The Influence of Diabetic Foot Exercise in Sensory Peripheral Neuropathy with Monofilament Test on Diabetes Mellitus Clients. *Jurnal Ners, 14*(3), 340–344. https://doi.org/10.20473/jn.v14i3.17263

Sun, H., Saeedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B. B., ... & Magliano, D. J. (2022). IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes research and clinical practice*, *183*, 109119. https://doi.org/10.1016/j.diabres.2021.109119

Syaipuddin, S., Haskas, Y., & Nurbaya, S. (2023). The effect of diabetic foot exercise on the effectiveness of blood sugar levels in type 2 diabetes mellitus patients at The Tamalanrea Jaya Health Center Makassar City. *Science Midwifery*, *10*(6), 4581-4587. https://doi.org/10.35335/midwifery.v10i6.1180

WHO. (2023). Diabetes. https://www.who.int/news-room/fact-sheets/detail/diabetes

Widyaningsih, D. S., Prasetyowati, A. T., Harwanto, A., & Goenka, S. (2022). Newspaper Leg Exercise to Reduce the Type 2 Diabetes Mellitus Physical Symptoms. *Journal of Health Sciences and Medical Development*, *1*(02), 83-91. https://doi.org/10.56741/hesmed.v1i02.141

Yusnita, E., Asra, A., Sulesmi, S., & Lusiani, M. (2020). Influnce of Health Education Using Audiovisual Foot Exercises of Knowledge and Specialization in Patients with Diabetes Mellitus at Rsud Dr. Dradjat Prawiranegara Serang. *Journal of Industrial Engineering & Management Research*, *1*(4), 36-45. https://doi.org/10.7777/jiemar.v1i4.100