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The Impact of Diabetic Foot Exercises and Warm Water Foot Soaking Intervention

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Abstract

Abstract: This study investigates the efficacy of diabetic foot exercises and warm water foot soaking in improving peripheral blood circulation in patients with diabetes mellitus. A paired samples test was conducted to assess the correlation between pre- and post-intervention data. The results revealed a significant correlation ($p < 0.05$), indicating the effectiveness of the interventions in enhancing peripheral blood circulation. Warm water foot soaking alleviated pain by stimulating endorphin production and dilating blood vessels, while diabetic foot exercises contributed to improved circulation and ulcer prevention. The combined approach holds promise for integrating into comprehensive diabetes care programs to enhance patients' quality of life and prevent complications.

Keywords: Diabetes Mellitus, Peripheral Blood Circulation, Diabetic Foot Exercises, Warm Water Foot Soaking, Intervention

1. Introduction

Diabetes Mellitus (DM) is a metabolic disorder primarily affecting carbohydrate metabolism, caused by a deficiency or absence of insulin hormone from pancreatic beta cells, or due to impaired insulin function, or both (Hasaini et al., 2023). This condition is divided into two main types, namely Diabetes Mellitus type I (insulin-dependent diabetes mellitus) and Diabetes Mellitus type II (non-insulin-dependent diabetes mellitus). The prevalence of DM continues to rise, both nationally and globally. The latest data from the International Diabetes Federation (IDF) in 2015 shows that the number of individuals suffering from diabetes reached 415 million and is projected to continue increasing to around 642 million by 2040, with a 55% increase. Indonesia also experiences a similar trend, placing the country seventh out of ten countries with the largest number of diabetes patients worldwide, estimated at 10 million (Vaghasloo, 2020).

According to the 2013 Regional Health Survey (RISKESDAS) data, the prevalence of diabetes in Indonesia reached 6.8% (Vaghasloo, 2020). Meanwhile, data from the Surakarta Health Office shows an increasing prevalence of diabetes from year to year. In 2005, the prevalence of diabetes patients was 3008 per 100,000 population, which increased to 4506 per 100,000 population in 2006. The number of diabetes patients also significantly increased from 43,312 individuals in 2005 to 46,465 individuals in 2006.

Attention to the management and treatment of DM is also evident from the data on the number of type 2 diabetes patients undergoing outpatient treatment at Dr. Moewardi Surakarta Hospital. In 2013, there were 8,118 patients undergoing outpatient treatment, which then experienced a slight decrease in 2014 and 2015. However, data from January to May 2015 show that the number of outpatient DM patients at Dr. Moewardi Surakarta Hospital was 3,150 patients. A preliminary study conducted in 2017 in Room Melati 1 of Dr. Moewardi Hospital showed that the total number of DM patients in 2016 in that room reached 452 patients.

One approach taken in the management of DM is through leg exercises. Leg exercises aim to improve blood circulation so that nutrients can be distributed more smoothly to body tissues, strengthen small muscles, calves, and thighs, as well as address joint mobility limitations often experienced by DM patients (Farnia et al., 2019). Additionally, leg exercises can also serve as a training method to strengthen and stretch muscles in the lower limbs,

especially in the ankles and toes. In addition to leg exercises, soaking in warm water is also one of the methods that can be used in DM management. Soaking in warm water has a positive effect on blood circulation in DM patients. The appropriate temperature of warm water can improve blood flow in blood vessels and cause vasodilation reactions, which in turn will help increase blood circulation in DM patients (Farnia et al., 2019).

According to Farnia et al., (2019) as cited in Suandika (2015), the benefits of hot water can be widely utilized in treatment due to its true effects and benefits. Tissue metabolism occurs alongside an increase in the exchange between body chemicals and body fluids. The biological effect of heat can cause dilation of blood vessels, leading to increased blood circulation. The assessment of peripheral circulation in diabetic foot exercises and foot soaking in warm water can be evaluated using indicators such as the Ankle Brachial Index (ABI). ABI is a non-invasive vascular examination used to detect signs and symptoms of ischemia, decreased peripheral perfusion that can result in blood circulation in the foot area can be measured through non-invasive examinations, one of which is the Ankle Brachial Index.

The reason why soaking feet in warm water and diabetic foot exercises can address circulation disorders in diabetic patients is because, in addition to having almost the same function, both activities strengthen peripheral blood circulation. According to Sidiq (2023) water is an appropriate therapeutic medium for injury recovery because scientifically warm water has physiological effects on the body. Firstly, it affects blood vessels by making blood circulation smoother. Secondly, the loading factor in the water strengthens muscles and ligaments that affect body joints. Additionally, warm water temperature increases tissue flexibility. Water is utilized as a trigger to improve strength levels and resistance to diseases. Water therapy is a good way to increase immune function, improve blood circulation, and trigger toxin elimination. According to Sidiq (2023), the function of diabetic foot exercises is to improve blood circulation, strengthen small foot muscles, prevent foot deformities, increase calf muscle strength, thigh muscle strength, and overcome joint movement limitations. The researcher conducted a preliminary study by interviewing 23 patients in October 2023. It was found that 18 patients were still unaware of and did not pay attention to foot care, health prevention, and foot hygiene. Meanwhile, 5 patients were already aware of prevention, care, and foot health to avoid DM complications.

2. Method

The type of research employed in this study is correlational research, aimed at determining whether there is a relationship between two or more variables. This study utilizes a one-group pretest-posttest design. This design does not include a control group, but rather, an initial observation (pretest) is conducted, allowing the researcher to examine changes that occur after the experiment (Mahdalena et al., 2019). This study involves conducting an initial observation of Ankle Brachial Index (ABI) examination results, then after the treatment, a re-measurement of ABI is performed. The treatment involves conducting diabetic foot exercises followed by soaking the feet in warm water.

The population was derived from secondary data consisting of the number of diabetes patients from October to December 2023 in Melati 1 ward, totaling 130 patients. The focus of this study is on the population of diabetes mellitus (DM) patients in Melati 1 ward at Dr. Moewardi Regional General Hospital. Sampling technique employed is non-probability sampling using purposive sampling. The sample consists of 56 respondents.

3. Results and Discussion

Gender: Females tend to have higher levels of LDL or "bad" cholesterol with higher triglyceride levels compared to males. There are also differences in performing all daily activities and lifestyles that significantly influence the occurrence of a disease, and this is one of the risk factors for the onset of Diabetes Mellitus.

The average amount of fat in adult males ranges from 15-20% of total body weight, and in females, it is around 20-25%. Therefore, the increase in lipid levels (blood fats) in females is higher than in males, making the risk factors for Diabetes Mellitus in females 3-7 times higher compared to males, which is 2-3 times.

Table 1: Characteristic Gender

Characteristic	Frequency	Percentage (%)
Female	37	66
Male	19	34

Gender distribution is a crucial aspect to consider in any research study, especially in health-related investigations like this one on diabetes mellitus. In this case, the table indicates that out of the total 56 respondents, a majority, comprising 37 individuals or 66%, are female. Conversely, male respondents make up the remaining 34% of the sample, totaling 19 individuals. Such a gender disparity within the sample could potentially influence various aspects of the study, including disease prevalence, treatment responses, and healthcare-seeking behaviors.

Beyond gender, the table also sheds light on the educational background of the respondents. It delineates respondents across different educational levels, namely elementary school (SD), junior high school (SMP), senior high

school (SMA), and those with a diploma. This segmentation provides valuable insights into the educational diversity within the sample population. Understanding the educational background of participants is essential as it can influence health literacy, access to healthcare services, and compliance with treatment regimens.

By presenting this demographic information in a clear and concise tabular format, the table facilitates a better understanding of the characteristics of the study population. Such insights are pivotal for researchers and healthcare practitioners alike, as they help tailor interventions and strategies to address the specific needs of different demographic groups effectively.

Table 2: Educational Background Distribution

Characteristic	Frequency	Percentage (%)
SD (Elementary School)	18	32
SMP (Junior High School)	15	27
SMA (Senior High School)	16	28
Diploma	7	13
Total	56	100

The table provides an insightful breakdown of the educational background of the respondents, categorizing them into four distinct levels: SD (Elementary School), SMP (Junior High School), SMA (Senior High School), and Diploma.

Among the respondents, the most common educational level is SMA (Senior High School), with 16 individuals, accounting for 28% of the total sample. This is closely followed by respondents with an educational background in SD (Elementary School), comprising 18 individuals or 32% of the total. Meanwhile, respondents with a background in SMP (Junior High School) constitute 15 individuals, representing 27% of the sample. Lastly, those with a diploma level of education are the smallest group, comprising 7 individuals, or 13% of the total respondents.

Understanding the educational distribution of the sample population is crucial for several reasons. Educational attainment can significantly impact health outcomes, as individuals with higher levels of education often possess better health literacy and are more likely to engage in health-promoting behaviors. Additionally, educational background can influence access to healthcare services, socioeconomic status, and overall well-being.

By presenting this information in a clear and concise manner, the table facilitates a deeper understanding of the educational diversity within the sample population. This knowledge is invaluable for researchers and healthcare professionals in tailoring interventions and educational initiatives to address the specific needs of different educational groups effectively.

3.1. Pre-Diabetic Foot Exercise and Warm Water Foot Soaking Ankle Brachial Index (ABI) Values

Prior to the diabetic foot exercise and warm water foot soaking, the most prevalent ABI value was in the moderate range, with 43 respondents (77%) falling into this category. The measurements obtained before the diabetic foot exercise and warm water foot soaking revealed that the majority of ABI values ranged from 0.43 to 0.71. The median ABI value before the diabetic foot exercise indicated a value of 0.59. This suggests that for most respondents, the ankle brachial index could be interpreted as moderate arterial impairment.

Subsequent to the diabetic foot exercise and warm water foot soaking, the median ABI value was recorded at 0.64. This indicates that for the majority of respondents, the ABI values could still be interpreted as moderate arterial impairment. These findings are consistent with those of Wardani et al. (2019), who reported an average ABI value of 0.62 among type 2 diabetes mellitus (DM) patients, interpreted as moderate obstruction. The obtained ABI values during foot screening indicate a concerning trend where patients with DM generally experience peripheral arterial vessel impairment.

This segment of the study underscores the importance of monitoring ABI values in diabetic patients, particularly before and after interventions such as foot exercises and warm water foot soaking. It highlights the prevalence of moderate arterial impairment among respondents and emphasizes the need for targeted interventions to address vascular health in this population.

3.2. Post-Diabetic Foot Exercise and Warm Water Foot Soaking Ankle Brachial Index (ABI) Values

Following the intervention, the most prevalent ABI value recorded was within the moderate range, with 51 respondents (91%) falling into this category. The measurements of ankle brachial index values after the diabetic foot exercise and warm water foot soaking ranged from 0.49 to 0.75. The median ABI value recorded after the intervention remained at 0.64.

The foot movements performed during diabetic foot exercises, akin to foot massages, apply pressure and movement to the feet, influencing hormone secretion such as increasing endorphin secretion, which functions to alleviate pain. This process also induces vasodilation of blood vessels, leading to a decrease in blood pressure, particularly systolic brachial pressure, which directly correlates with ABI values. Diabetic foot exercises promote relaxation and improve blood circulation. Improved blood circulation due to movement stimulation facilitates the delivery of oxygen and nutrients to body cells, as well as aids in the removal of toxins (Hasneli, & Novayelinda, 2012).

This section of the study emphasizes the positive effects of diabetic foot exercises and warm water foot soaking on vascular health, as indicated by the post-intervention ABI values. The majority of respondents experienced improvements in ABI values, reflecting enhanced arterial circulation and overall vascular function. These findings underscore the significance of incorporating such interventions into diabetic care regimens to mitigate the risk of vascular complications and promote overall health and well-being in diabetic patients.

3.3. The Effect of Diabetic Foot Exercises and Soaking the Feet in Warm Water on Peripheral Blood Circulation in Diabetes Mellitus Patients

The results of the Paired Samples statistical test showed that there was a significant correlation between the data before and after the application of diabetic foot exercises and soaking the feet in warm water ($p = 0.002$). This indicates that there is a real effect of this intervention on peripheral blood circulation in diabetes mellitus patients. Previous research has shown that diabetic foot exercises and warm water foot soaks can improve peripheral blood circulation, help relieve pain, and improve patient well-being.

Soaking the feet in warm water has the effect of stimulating the production of endorphins, which have analgesic properties, reducing pain. This therapy also improves blood circulation by widening blood vessels, so that more oxygen is supplied to swollen tissues. Apart from that, improving blood circulation also improves lymph circulation, cleanses the body of toxins, and relieves various health problems such as rheumatism, arthritis, sciatica, and others. Previous research shows that leg blood circulation is influenced by blood viscosity, length and diameter of blood vessels. Diabetes mellitus (DM) can cause a buildup of blood sugar which affects blood viscosity and disrupts blood flow throughout the body, resulting in decreased perfusion to body tissues. Therefore, diabetic foot exercises and foot soaking therapy aim to improve blood circulation, prevent ulcers on the feet, and reduce the risk of cardiovascular disease.

The combination of diabetic foot exercises and foot soaking therapy has the same goal, namely improving peripheral blood circulation. DM patients who undergo regular foot care have a lower risk of developing diabetic ulcers. The stages of implementing foot exercise therapy after soaking the feet in warm water also involve a foot massage procedure, which can improve blood and lymph circulation, increase the delivery of oxygen and nutrients to body cells, and help remove metabolic waste from the body.

4. Conclusion

In conclusion, the findings of this study highlight the significant impact of diabetic foot exercises and warm water foot soaking on peripheral blood circulation in patients with diabetes mellitus. Statistical analysis revealed a meaningful correlation between pre- and post-intervention data, indicating the efficacy of these interventions in improving peripheral blood circulation.

Warm water foot soaking effectively alleviates pain by stimulating endorphin production and enhances blood circulation by dilating blood vessels, thereby facilitating the supply of oxygen to swollen tissues and aiding in the removal of toxins. Additionally, diabetic foot exercises contribute to improved peripheral blood circulation, ulcer prevention, and reduced risk of cardiovascular diseases.

The combined approach of diabetic foot exercises and foot soaking therapy serves as an effective strategy to enhance peripheral blood circulation in diabetic patients. This intervention has the potential to be integrated into comprehensive diabetes care programs, ultimately improving patients' quality of life and preventing complications associated with peripheral blood circulation disorders.

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