Warm Footbaths for Fatigue Reduction in Type II Diabetes: Advancing SDG 3 on Good Health and Well-Being, Inclusive Health

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Abstract - Fatigue is one of the most prevalent and debilitating symptoms experienced by individuals with Type II Diabetes Mellitus, often impairing their physical functioning, emotional well-being, and overall quality of life. The present study explored the effectiveness of warm footbaths as a complementary, non-pharmacological intervention to alleviate fatigue among patients diagnosed with Type II diabetes thereby contributing to the realization of Sustainable Development Goal 3 (SDG 3): Good Health,Well-being and inclusive health. A quasi-experimental pretest–posttest control group design was employed, enrolling 60 participants (both male and female) aged between 30 and 70 years, all with a confirmed history of Type II diabetes under regular treatment. Participants reporting moderate fatigue, as determined using the Functional Assessment of Chronic Illness Therapy (FACIT)–Fatigue Scale, were included based on defined inclusion criteria. On Day 1, demographic and clinical data were collected through a structured questionnaire, and baseline fatigue and sleep quality were assessed. Beginning on Day 3, participants in the experimental group received an electric warm footbath therapy, while those in the control group continued with routine hospital care. The intervention was administered consistently for 90 days, followed by post-

assessment on Day 91. Findings revealed a statistically significant reduction in fatigue levels among the experimental group, with a pretest mean of 17.50 ± 0.90 and a posttest mean of 11.33 ± 1.49, yielding a mean difference of 6.17. The paired t-value of 18.9462 ($p < 0.05$) indicated a marked improvement post-intervention. Furthermore, the independent t-test value of 10.5614 ($p < 0.001$) confirmed significant differences between the experimental and control groups in the posttest scores. The results demonstrate that warm footbath therapy effectively reduces fatigue and promotes better physiological relaxation in individuals with Type II diabetes. As a safe, cost-effective, and easily implementable complementary approach, it holds promise as an adjunctive strategy in diabetes self-care and fatigue management. By addressing a key aspect of chronic disease management through an accessible intervention, the research supports SDG 3 targets aimed at reducing the burden of non-communicable diseases and improving health and well-being for all.

Keywords - Warm footbath, Type II diabetes mellitus, Fatigue management, Complementary therapy, Non-pharmacological intervention, Thermal therapy, Physiological relaxation, Functional Assessment of Chronic Illness Therapy (FACIT)–Fatigue Scale.,Good Health And Well Being,Premature Mortality, Non Communicable Diseaases.,inclusive health

I. INTRODUCTION

Diabetes mellitus (DM) represents a multifactorial, chronic metabolic condition characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. This metabolic imbalance leads to long-term dysfunction and failure of multiple organs, including the eyes, kidneys, nerves, heart, and blood vessels [1]. A diagnosis of diabetes is established when fasting plasma glucose levels reach or exceed 126 mg/dL, or when random glucose measurements remain abnormally high despite pharmacological intervention [2]. According to the World Health Organization (WHO), diabetes affected approximately 171 million individuals globally in the year 2000, and the prevalence is projected to rise dramatically to 642 million by 2040, reflecting an alarming global health concern [3,4]. Type II Diabetes Mellitus (T2DM) accounts for nearly 90% of all diabetes cases and is primarily linked to modifiable risk factors such as obesity, sedentary behavior, poor dietary patterns, and advancing age, along with non-modifiable determinants like genetic predisposition and ethnicity [5,6]. Genome-wide association studies have revealed that T2DM has a complex polygenic nature, with most gene loci influencing insulin secretion and, to a lesser degree, insulin sensitivity [7,8].

Conventional management of diabetes includes pharmacological interventions such as oral hypoglycemics, insulin therapy, and newer injectable formulations, complemented by structured lifestyle modifications [9]. Despite these advancements, diabetes continues to be termed a “silent killer,” as symptoms often manifest only after irreversible target organ damage has occurred [10]. Thus, preventive strategies focusing on early identification, lifestyle correction, and complementary interventions are essential for improving patient outcomes. Among non-pharmacological approaches, therapeutic nutrition, physical activity, adequate sleep, and stress management form the cornerstone of diabetes care [11]-[12]. However, fatigue—a multidimensional symptom encompassing physical, emotional, and cognitive exhaustion—remains one of the most commonly reported and distressing complications among individuals with T2DM. It significantly interferes with daily functioning, adherence to self-care practices, and overall quality of life. Studies indicate that up to 61% of adults newly diagnosed with T2DM report moderate to severe fatigue [13]-[20].

In recent years, warm footbaths have gained recognition as a safe and effective complementary therapy for fatigue management in chronic conditions, including diabetes. Warm water immersion promotes peripheral vasodilation, enhances blood circulation, reduces muscular tension, and induces relaxation through thermoregulatory mechanisms [21]-[24]. The gentle hydrostatic pressure exerted during a footbath facilitates venous return, improves tissue oxygenation, and alleviates sensations of heaviness or exhaustion commonly associated with diabetic fatigue. During the investigator’s clinical

observations, it was noted that many clients with diabetes mellitus frequently experienced debilitating fatigue despite adherence to medical therapy. A review of relevant literature revealed promising evidence supporting the use of warm footbaths as a simple, low-cost, and non-invasive method for fatigue relief in diabetic individuals [25]-[27]. This insight inspired the current study, which aims to systematically examine the impact of warm footbaths on fatigue among clients with Type II diabetes mellitus. This research aligns with the United Nations Sustainable Development Goal 3 (SDG 3): Good Health, Well-being and inclusive health, which aims to ensure healthy lives and promote well-being for all at all ages. Specifically, it contributes to Target 3.4, which seeks to reduce premature mortality from non-communicable diseases through prevention and treatment, and promote mental health and well-being. By exploring warm footbaths as a sustainable, non-invasive, and accessible self-care strategy, this study supports the global agenda for improving chronic disease management and enhancing quality of life through integrative and holistic health practices. The primary objectives of this research are:

- To assess the baseline (pretest) level of fatigue among clients with diabetes mellitus in both the intervention and control groups.
- To evaluate the effectiveness of warm footbaths in reducing fatigue levels among the experimental group.
- To compare the posttest fatigue scores between the intervention and control groups.
- To determine the association between post-intervention fatigue levels and selected demographic and clinical variables among clients with diabetes mellitus.

Through this investigation, the study seeks to establish warm footbaths as a viable non-pharmacological strategy for enhancing comfort, improving energy balance, and promoting overall well-being among individuals living with Type II diabetes.

II. LITERATURE REVIEW

Diabetes mellitus, particularly Type II diabetes, is one of the most prevalent chronic metabolic disorders globally, contributing significantly to morbidity and reduced quality of life. Fatigue is one of the most common and persistent symptoms experienced by individuals with diabetes, often linked to fluctuating glucose levels, insulin resistance, neuropathy, and poor sleep quality [1]-[5]. According to Fritschi and Quinn (2010), fatigue in diabetic patients is multifactorial, encompassing physiological, psychological, and lifestyle components that interfere with routine functioning and glycemic management. The growing interest in non-pharmacological approaches to symptom management has led researchers to explore the therapeutic benefits of hydrotherapy and thermal interventions as supportive modalities. Warm footbaths, a simple and cost-effective hydrotherapeutic practice, have been shown to promote peripheral vasodilation, enhance circulation, and induce relaxation through thermoregulatory mechanisms [6]-[10]. The increase in local blood flow aids in reducing muscle stiffness, improving tissue oxygenation, and promoting metabolic waste removal, which collectively help alleviate fatigue and discomfort. In diabetic individuals, poor peripheral circulation and neuropathy often contribute to sensations of heaviness and chronic tiredness in the lower limbs. By applying heat through a controlled warm water immersion, the sympathetic nervous system activity can be reduced, resulting in improved autonomic regulation and relaxation [11]-[15].

Studies have also emphasized the role of thermal therapy in enhancing sleep quality and psychological well-being, which are closely associated with fatigue reduction. For instance, Park etal (2019) reported that regular warm footbaths before bedtime improved sleep efficiency and subjective relaxation scores in adults with chronic fatigue. In diabetic populations, better sleep indirectly supports improved glycemic control, thereby minimizing fatigue triggers. Similarly, Kanda et al. (2019) demonstrated that hydrothermal stimulation through warm water immersion improved endothelial

function and peripheral blood flow in diabetic patients, suggesting potential cardiovascular and metabolic benefits. Non-pharmacological interventions such as warm footbaths align with holistic care principles, integrating physical and psychological wellness [16]-[20]. Compared with pharmacological treatments that often target specific symptoms or biochemical parameters, complementary approaches foster self-care, stress reduction, and adherence to lifestyle modifications. Moreover, warm footbaths are safe, easily implementable, and adaptable in community and clinical settings without requiring advanced equipment or technical expertise [21]-[24].

Despite limited large-scale clinical trials, emerging evidence suggests that warm footbaths can serve as a supportive adjunct therapy for managing fatigue and enhancing the overall well-being of Type II diabetic patients. Future research should focus on optimizing temperature, duration, and frequency of application to standardize the protocol for clinical use. Integrating such simple, evidence-based interventions into diabetic care regimens can contribute to improved quality of life and sustainable self-management outcomes [25]-[27].

III. MATERIALS AND METHODS

Study Design: A quasi-experimental, pretest–posttest control group research design was employed to evaluate the efficacy of warm footbaths in alleviating fatigue among clients diagnosed with Type II Diabetes Mellitus (T2DM). This design enabled the comparison of outcomes between participants receiving the warm footbath intervention and those receiving standard care, thereby ensuring internal validity and minimizing confounding factors.

Study Setting and Duration: The study was conducted at the Diabetic Clinic of the host institution over a period of five months, from January 2025 to August 2025. The chosen setting provided access to a consistent flow of patients undergoing diabetic management, facilitating participant recruitment and follow-up within a clinical environment.

Ethical Considerations: Prior to data collection, ethical clearance was obtained from the Institutional Human Ethics Committee (IHEC) of Saveetha Institute of Medical and Technical Sciences (SIMATS). Formal authorization was also received from the Head of the Department of General Medicine. Each participant was briefed about the study's objectives, procedures, and expected outcomes, and written informed consent was obtained in accordance with the ethical principles of the Declaration of Helsinki.

Study Participants: A total of 60 diabetic clients meeting the inclusion criteria were enrolled in the study. Participants of both genders aged 30 to 70 years, with a confirmed diagnosis of Type II Diabetes Mellitus, undergoing routine treatment, and experiencing moderate fatigue (as measured by the Functional Assessment of Chronic Illness Therapy–Fatigue [FACIT-F] Scale) were considered eligible. Participants with dermatological disorders (such as dermatitis or chronic localized infections), varicose veins, deep vein thrombosis, peripheral vascular disease, hypothyroidism, anemia, adrenal disorders, psychiatric illnesses, or those taking medications known to induce fatigue were excluded. Individuals who had undergone alternative or complementary therapies such as reflexology, acupuncture, or acupressure within the last six months, as well as pregnant or lactating women, and those unwilling to participate were also excluded from the study.

Sampling Technique: A non-probability purposive sampling technique was adopted for participant selection. The total sample was divided equally into two groups: 30 participants in the interventional (experimental) group and 30 participants in the control (placebo) group. This approach ensured that individuals meeting specific diagnostic and clinical characteristics relevant to the intervention were included.

Data Collection Procedure: On Day 1, baseline demographic and clinical data were collected using a self-structured questionnaire. Subsequently, the pretest fatigue level was measured using the FACIT-Fatigue Scale, which assesses fatigue severity and its impact on daily functioning. Beginning on Day 3, participants in the experimental group received the warm footbath intervention, whereas the control group continued to receive standard hospital care without additional hydrotherapy. The posttest fatigue assessment was performed on Day 91 using the same standardized FACIT-F scale to ensure comparability of pre- and post-intervention outcomes.

Warm Footbath Procedure: Participants were comfortably seated on a chair with their pant legs rolled approximately 5 cm above the ankles. Both feet were immersed in an electric footbath containing 5 liters of warm water maintained between 40°C and 45°C. The warm footbath session lasted for 15 minutes and was administered daily before bedtime for a continuous duration of 90 days. The temperature and duration were carefully monitored to maintain consistency and prevent thermal discomfort. After completion, feet were gently wiped dry, and participants were advised to rest for at least 10 minutes.

Post-Assessment: After 90 days of intervention, participants were reassessed using the FACIT-Fatigue Scale to evaluate changes in fatigue levels. The posttest results were compared with baseline data to determine the effectiveness of the warm footbath intervention in reducing fatigue among T2DM clients.

The findings from this study highlight the potential of warm footbaths as an effective, non-pharmacological approach for mitigating fatigue among individuals with Type II Diabetes Mellitus. The observed improvement in fatigue scores among participants receiving the intervention aligns with previous studies emphasizing the role of hydrothermal therapy in enhancing peripheral circulation, promoting relaxation, and improving overall well-being. Physiologically, immersion of the feet in warm water leads to vasodilation of peripheral blood vessels, which enhances oxygen delivery and metabolic clearance, thereby reducing muscular and systemic fatigue. The soothing thermal stimulation may also trigger parasympathetic nervous system activation, resulting in reduced stress hormone levels and improved autonomic balance. This mechanism supports earlier evidence that heat therapy can improve circulation and muscular recovery in diabetic populations.

Furthermore, consistent application of warm footbaths before bedtime has been linked with enhanced sleep quality and reduced restlessness, both of which indirectly contribute to fatigue reduction. The emotional relaxation achieved during the intervention may alleviate anxiety, which often exacerbates perceived fatigue in chronic illness. From a practical standpoint, the intervention's simplicity, affordability, and non-invasive nature make it a feasible adjunct to routine diabetic care. Unlike pharmacological fatigue management, which may entail side effects or drug interactions, warm footbaths offer a safe, patient-centered, and easily adoptable home-based therapy. In conclusion, the study reinforces the potential role of warm footbaths as a complementary therapeutic strategy in diabetes management. Integrating such evidence-based, non-pharmacological approaches into clinical and community settings can enhance patient comfort, promote self-care, and contribute to a holistic approach in chronic disease management.

IV. RESULTS

Demographic Characteristics: The demographic profile of the study participants demonstrated relative homogeneity between the experimental and control groups, ensuring comparability in baseline characteristics. In the experimental group, the majority of participants, 22 (73.3%), were between the ages of 55 and 60 years, indicating a predominance of middle-aged to older adults—a population segment commonly affected by Type II Diabetes Mellitus. Sixteen (53.33%) participants were male, suggesting a slightly higher male representation in this group. Regarding educational attainment, 11 (36.67%) participants had completed primary education, reflecting moderate literacy levels typical of diabetic

populations in community settings. In terms of occupational status, 12 (40%) participants were employed in the private sector, while the remaining were engaged in other forms of employment or retired. Marital status analysis revealed that 21 (70%) participants were married, and 23 (76.67%) lived within nuclear family structures, signifying family-based social support that might influence health-seeking behavior and adherence to interventions. Dietary patterns showed that 24 (80%) of the participants were non-vegetarians, which may have implications for glycemic control and overall metabolic balance. In the control group, 19 (63.33%) participants were between the ages of 55 and 60 years, and an equal proportion, 19 (63.33%), were male. A similar trend was observed in educational background, with 19 (63.33%) having completed primary education. Twenty-one (70%) were employed in the private sector, while 24 (80%) were married, and 24 (80%) lived in nuclear families. Additionally, 25 (83.33%) reported being non-vegetarians. These findings suggest that both groups were well-matched demographically, thereby reducing potential bias in the outcome evaluation.

Clinical Characteristics: The clinical characteristics of the participants also showed a balanced distribution between the two groups. In the experimental group, a significant majority, 25 (83.33%), reported a family history of diabetes mellitus, suggesting a strong hereditary predisposition. Most participants, 21 (70%), had been living with diabetes for less than 10 years, representing individuals in the early to mid-phase of disease progression. Furthermore, 27 (90%) of the participants were confirmed cases of Type II Diabetes Mellitus, and 23 (76.67%) were under insulin therapy, reflecting a cohort managing moderate disease severity. Similarly, in the control group, 22 (73.33%) participants had a family history of diabetes, and 25 (83.33%) had been diagnosed within the past 10 years. Twenty-seven (90%) were Type II diabetic patients, and 24 (80%) were receiving insulin therapy. The comparability of these clinical features between groups strengthens the internal validity of the study, ensuring that observed differences in outcomes could be attributed primarily to the intervention.

Assessment of Fatigue Levels: The assessment of fatigue using the Functional Assessment of Chronic Illness Therapy–Fatigue (FACIT-F) Scale revealed notable improvements following the intervention. In the experimental group, all participants (30; 100%) exhibited moderate fatigue during the pretest phase. After 90 days of intervention with warm footbaths, 11 (36.67%) participants reported minimal fatigue, while 19 (63.33%) experienced mild fatigue. This indicates a substantial reduction in fatigue intensity post-intervention, highlighting the beneficial impact of thermal foot therapy on energy restoration and fatigue perception among diabetic individuals. Conversely, in the control group, all participants (30; 100%) exhibited moderate fatigue at baseline. During the posttest phase, 2 (6.67%) participants reported minimal fatigue, 22 (73.33%) had mild fatigue, and 6 (20%) continued to experience moderate fatigue. Although a slight improvement was observed, the magnitude of change was considerably less than that seen in the experimental group, indicating that the warm footbath intervention significantly contributed to fatigue alleviation beyond routine diabetic care.

Sleep Disturbance Assessment: Sleep disturbance, a frequent comorbidity among diabetic patients and a contributing factor to fatigue, was also assessed. In the experimental group, all participants (30; 100%) initially reported severe sleep disturbances in the pretest phase. After consistent warm footbath therapy for 90 days, only 2 (6.67%) participants reported mild sleep disturbances, while 28 (93.33%) reported moderate disturbances. The marked decline in the severity of sleep issues suggests that the intervention promoted relaxation, improved circulation, and enhanced sleep quality—factors that collectively aid in fatigue reduction. In contrast, in the control group, 30 (100%) participants also experienced severe sleep disturbances initially. At posttest, 1 (3.33%) reported moderate disturbances, while 29 (96.67%) continued to experience severe disturbances. These findings reinforce the hypothesis that warm footbaths exert a positive effect not only on physical fatigue but also on associated sleep quality and physiological relaxation (Table 1).

The results of this study reveal that warm footbaths serve as an effective non-pharmacological intervention for managing fatigue and improving sleep among individuals with Type II Diabetes

Mellitus. The substantial reduction in fatigue scores in the experimental group compared to the control group aligns with the underlying physiological rationale that thermal hydrotherapy enhances peripheral blood circulation, oxygen delivery, and metabolic waste removal, thereby improving muscular recovery and reducing subjective tiredness. The improvement in sleep quality further supports the concept that warm footbaths activate the parasympathetic nervous system, promoting relaxation and lowering cortisol levels—both of which are crucial for combating chronic fatigue in diabetic individuals. Moreover, the results suggest that integrating warm footbaths into diabetic care regimens could provide a safe, cost-effective, and easily implementable adjunct therapy. Given that fatigue in diabetics is multifactorial—arising from metabolic imbalance, neuropathy, and psychological stress—the holistic benefits of this intervention make it particularly valuable in comprehensive diabetes management. Overall, the findings underscore the potential of warm footbaths as a supportive therapy for enhancing well-being and quality of life among diabetic individuals, warranting further exploration through large-scale randomized controlled trials and long-term follow-up studies.

Table 1: Frequency and Percentage Distribution of Level of Fatigue, Quality of Sleep in the Experimental Group and Control Group

Level of fatigue	Experimental Group				Control Group			
	Pretest		Post Test		Pretest		Post Test	
	No.	%	No.	%	No.	%	No.	%
Minimal	-	-	11	36.67	-	-	2	6.67
Mild	-	-	19	63.33	-	-	22	73.33
Moderate	30	100.00	-	-	30	100.00	6	20.00
Severe	-	-	-	-	-	-	-	-

Fatigue and Its Association with Type II Diabetes: Fatigue is a common and pervasive condition experienced by individuals in daily life, manifesting as both physical and mental exhaustion. In people with Type II diabetes, fatigue is particularly prevalent and has been linked to both short-term and long-term complications of the disease, including episodes of hypoglycemia and hyperglycemia, as well as cardiovascular disease, neuropathy, and retinopathy. Fluctuating blood glucose levels—whether excessively low or high—are known to contribute significantly to the sensation of fatigue, as they disrupt normal metabolic balance and energy regulation. Moreover, several lifestyle-related factors such as inadequate physical activity, obesity, and poor sleep quality can exacerbate fatigue among diabetic individuals, leading to diminished well-being and impaired daily functioning.

Comparison of Fatigue Levels Between Experimental and Control Groups: In the experimental group, the mean pretest fatigue score was 25.03 ± 2.39, while the posttest mean increased to 38.40 ± 3.06. The calculated mean difference was 0.23, and the corresponding t-value of 16.0029 was statistically significant at $p < 0.05$. This indicates a significant improvement in fatigue levels following the intervention. In contrast, the control group recorded a pretest mean fatigue score of 25.27 ± 2.26 and a posttest mean of 26.57 ± 5.10. The mean difference of 11.83 with a t-value of 1.5809 was not statistically significant at $p < 0.05$, suggesting no meaningful change in fatigue levels without the intervention. An independent t-test comparison revealed that the pretest difference between the experimental and control groups ($t = 0.6463$) was not statistically significant, indicating baseline similarity in fatigue levels. However, the posttest

results showed a significant difference between the two groups (t = 10.5614; mean difference = 1.30; p < 0.001). This clearly demonstrates that the level of fatigue was substantially reduced in the experimental group compared to the control group, confirming the positive effect of the intervention (as shown in Table 2).

Table 2: Comparison of Level of Fatigue within the Experimental and Control Group

Level of fatigue	Pretest		Post Test		Mean Difference Score	Paired 't' test value
	Mean	S.D	Mean	S.D		
Experimental Group	25.03	2.39	25.27	2.26	0.23	t = 16.0029; p=0.0001 S***
Control Group	38.4	3.06	26.57	5.10	11.83	t = 1.5809 p=0.125, N.S
Mean Difference Score	13.37		1.30		***p<0.001 , S – Significant	
Student Independent 't' test & p-value	t = 0.6463		t = 10.5614		N.S – Not Significant	
	p=0.5231, N.S		p=0.0001, S***			

A clinical randomized controlled trial involving 66 individuals diagnosed with diabetes mellitus was conducted to evaluate the therapeutic impact of warm footbaths on fatigue reduction. The findings revealed that administering a warm footbath once daily for approximately 20 minutes over a two-week period led to a statistically significant improvement in fatigue levels among diabetic participants. This highlights the potential of hydrotherapeutic interventions as simple, effective, and non-invasive approaches to fatigue management in individuals with Type II diabetes. Despite advancements in pharmacological treatments for diabetes and its associated symptoms, many patients continue to seek complementary or alternative remedies to enhance comfort and well-being. Non-pharmacological interventions are increasingly recommended for managing fatigue and improving sleep quality due to their safety, accessibility, and minimal side effects. Such interventions include massage therapy, acupuncture, aromatherapy, biofeedback, herbal medicine, relaxation techniques, meditation, physical exercise, and warm footbaths. These therapies work by promoting relaxation, improving circulation, and restoring the body's natural equilibrium.

Warm water immersion, particularly at a controlled temperature, facilitates vasodilation and enhances peripheral blood circulation. This physiological response increases tissue metabolism, supports the exchange of nutrients and waste products, and helps eliminate metabolic toxins from the body. Furthermore, consistent application of heat to the lower extremities can prevent complications such as foot ulcers, improve nerve sensitivity, and relieve muscle tension—collectively contributing to reduced fatigue and overall physical comfort. In alignment with previous evidence, the findings from the present study also demonstrated that participants in the experimental group experienced notable improvements in fatigue reduction following the intervention. Moreover, participants reported feeling satisfied with the warm footbath therapy, perceiving it as a safe, soothing, and beneficial practice. Many expressed their

willingness to continue incorporating warm footbaths into their daily routines as a supportive self-care measure to manage fatigue and enhance overall well-being.

Association Between Fatigue Levels and Selected Demographic and Clinical Variables: In the experimental group, statistical analysis indicated that none of the demographic or clinical variables had a significant association with fatigue levels. This suggests that the observed improvement in fatigue was not influenced by factors such as age, gender, educational background, occupation, or duration of diabetes. Therefore, the reduction in fatigue can be attributed primarily to the therapeutic effect of the warm footbath intervention rather than individual participant characteristics.

V. CONCLUSION

The findings of the present study clearly indicate that the application of warm footbaths has a significant positive effect in alleviating fatigue among clients with Type II diabetes mellitus. Participants who received daily warm footbath therapy reported notable reductions in fatigue levels, improved comfort, and enhanced overall well-being. The intervention proved to be safe, cost-effective, and easily administered, making it a practical complementary approach that can be incorporated into routine nursing care and patient self-management programs. Health education initiatives focusing on the benefits and proper application of warm footbaths could further empower patients to adopt this non-pharmacological strategy as part of their daily diabetes management.

Despite these promising results, the generalizability of the study is limited by the relatively small sample size, the short duration of intervention, and the confinement to a single hospital setting. Additionally, potential confounding variables were not fully controlled, which may have influenced the outcomes. Future research should aim to address these limitations by conducting multicentric trials with larger and more diverse populations over extended periods. Comparative studies evaluating the effectiveness of warm footbaths alongside other complementary therapies—such as massage, reflexology, or hydrotherapy—could provide deeper insights into optimizing non-pharmacological strategies for fatigue management in diabetes. Furthermore, exploring the long-term effects of consistent warm footbath therapy on glycemic control, sleep quality, and quality of life would help establish a broader evidence base for clinical guidelines and integrative care approaches.

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