

Assess the Effects of Buerger-Allen Exercise on the Healing of Neuropathic Diabetic Foot Ulcers in Patients with Type 2 Diabetes

Mr Ajith M.¹, Mr Mohamed Sameer H.², Dr Padma Priya³, Ms Deepika D.⁴, Dr Karpagam K.⁵, Dr Sindhu Ramalingam⁶

¹Nursing Tutor, Department of Child Health Nursing, Saveetha College of Nursing

²BSc Nursing Final year, Saveetha College of Nursing

³Associate Professor, Department of Obstetrics and Gynaecological Nursing,

⁴Nursing Tutor, Department of Medical Surgical Nursing,

⁵Associate Professor, Department Medical Surgical Nursing

⁶Associate Professor, Department of Obstetrics and Gynaecological Nursing

Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

Abstract

Adopting a healthy lifestyle is essential for the prevention of lifestyle-related and chronic diseases, particularly in a world increasingly faced with the challenges of diabetes. Diabetes Mellitus, recognized as a global epidemic, can lead to severe complications. These ulcers not only hinder mobility but also significantly impair the quality of life for those affected. Buerger-Allen exercises emerge as a valuable therapeutic option. These non-invasive, atraumatic physiotherapy techniques are specifically designed to enhance peripheral circulation, thereby promoting improved wound healing and recovery. This randomised controlled trial investigated the impact of Buerger-Allen exercises on the healing process of neuropathic diabetic foot ulcers among a group of 60 patients with Type 2 Diabetes. The experimental group exhibited a mean difference score of 6.65 ($p < 0.05$), illustrating the effectiveness of these exercises in fostering improved recovery. The results of this study indicate that integrating Buerger-Allen exercises into the treatment regimen for diabetic foot ulcers could significantly accelerate healing, reduce the risk of complications, and enhance overall quality of life for patients. Nevertheless, future research must consider key factors such as sample size, duration of follow-up, adherence to the exercise protocol, and the control of diabetes to draw more comprehensive conclusions. This research underscores the promising role of Buerger-Allen exercises as a complementary therapy for the management of diabetic foot ulcers, particularly for those suffering from neuropathy. By incorporating such interventions, healthcare providers may open new avenues for improved patient outcomes and holistic care.

Keywords: Buerger – Allen exercise, Diabetes Mellitus, Foot Ulcer.

Introduction

A healthy lifestyle should be a part of your whole way of living. Maintaining a healthy lifestyle can aid in preventing long-term illnesses and chronic disorders. Maintaining your health and feeling good about yourself are critical to your self-esteem and self-perception.

Keep your lifestyle healthy by taking care of your body [1]. India is one of the developing

countries in the world, having 1.3 billion, of which 66% of the population resides in rural areas and 34% resides in urban areas. According to World Health Organization (WHO), Universal Health Coverage (UHC) is to enable all people and communities to use promotive, preventive, curative, rehabilitative, and palliative health care services they need, of sufficient quality to be effective, while also

ensuring that the use of these services does not expose the user to financial hardship. It incorporates equity in access, quality, and financial risk protection [2]. The pathogenic relationship between diabetes mellitus and hypertension is bidirectional. Hypertension in the diabetic individual markedly increases the risk and accelerates the course of cardiac disease, peripheral vascular disease, stroke, retinopathy, and nephropathy [14]. People with diabetes have a much higher risk of peripheral artery disease [3]. Exercises including elevation, mobility, and lower extremity rest are all part of the Buerger-Allen regimen [3]. Diabetes mellitus (DM) is a long-term metabolic condition that necessitates medical care as well as self-care practices, such as warm water foot baths and Buerger Allen exercises, to prevent complications. Diabetic ulcers are among the consequences of diabetes mellitus. Reduced foot sensitivity is the primary cause of diabetic ulcers [4]. In patients with Diabetes Mellitus (DM), Buerger-Allen Exercise (BAE) decreases Peripheral Neuropathy Symptoms (PNS) and increases Lower Extremity Perfusion (LEP) through the wound healing process [5]. Diabetes significantly raises the risk of peripheral artery disease and peripheral neuropathy; Buerger's Allen exercise is an easy way to improve peripheral circulation [6]. A serious consequence of diabetes, diabetic foot ulcers (DFUs) have a burden comparable to that of cancer. Peripheral neuropathy, vascular disease, deformities of the foot, and socioeconomic and regional factors are risk factors. Low-Level Laser Therapy (LLLT) facilitates wound healing, encourages tissue restoration, and reduces discomfort [7]. Exercise is the fundamental principle for preventing peripheral vascular disease among diabetes patients. One of the exercises is the Buerger Allen exercise is an active postural exercise of the feet and legs for preventing peripheral vascular disease and promoting collateral circulation in the lower extremities [8]. Buerger Allen Exercise (BAE) is an active

postural exercise that promotes collateral circulation in the lower extremities. But its application to managing patients with diabetic foot is very rare [9]. The other symptoms include cold skin, skin ulcers, bluish skin, or poor nail and hair growth in the affected leg. Complications also include an infection or tissue death, which may require amputation. While peripheral arterial disease is a major risk factor for lower-extremity amputation, it is also accompanied by a high risk for symptomatic cardiovascular and cerebrovascular disease [10]. Diabetes Mellitus has become a global epidemic and presents many complications [11]. This study deals with the analysis and interpretation of the data collected from 60 Type 2 diabetes patients, each in the experimental group and the control group, involved in the assessment of the level of effects of Buerger Allen exercise on the healing of neuropathic diabetic foot ulcers. The data was organised, tabulated and analysed according to the objectives.

Methodology

The study was conducted at Saveetha Medical College and Hospital, Chennai. A randomised controlled trial investigation involving sixty patients was conducted. The sample strategy employed was convenience sampling methods. Patients with Diabetic Foot Ulcers in Patients with Type 2 Diabetes made up the participants. The research approach would need to be developed to analyze both the efficacy of the exercise intervention and the ulcers' healing process to determine the impact of Buerger-Allen exercises on the healing of neuropathic diabetic foot ulcers in individuals with Type 2 diabetes. To make sure that the results are trustworthy and causally related to the intervention, a randomised controlled trial (RCT) would be a suitable research strategy. Two groups would participate in the study: one would do Buerger-Allen exercises as part of the experimental group, and the other would get routine foot ulcer healing therapy without the

exercise intervention. Patients with neuropathic foot ulcers and Type 2 diabetes would be the participants, and the inclusion criteria would ensure that the subjects had no additional serious conditions that could hinder their ability to recover, like infections or serious cardiovascular illness. The Buerger-Allen exercises' frequency, duration, and intensity would be determined by the technique, while the control group would get standard care for wounds and diabetes. Along with subjective metrics like pain and quality of life, data on ulcer size, depth, and healing time would be gathered and evaluated at baseline, midway through the study, and at the end of the study. Wound healing rates, ulcer size changes, and any negative consequences or complications would be among the outcome measures. The differences between the experimental and control groups would be compared using statistical analysis, such as ANOVA or t-tests. Getting participants' informed consent, protecting patient privacy, and keeping an eye out for any negative impacts throughout the

study would all address ethical issues. This approach would enable a thorough assessment of whether Buerger-Allen exercises can help people with Type 2 diabetes repair their neuropathic diabetic foot ulcers.

Results

Section A: Demographic characteristics of patients with type 2 diabetes, including their frequency and percentage distribution, were analysed to assess the effect of Buerger Allen exercise on the healing of neuropathic diabetic foot ulcers in both the experimental and control groups. As shown in Table 1, a significant portion of the subjects—28 (46.67%) in the experimental group and 32 (53.33%) in the control group—belong to the age range of 61 to 70; in terms of gender, 31 (51.67%) in the experimental group and 33 (53.33%) in the control group are male; regarding dietary habits, 40 (66.67%) in the experimental group and 43 (71.67%) in the control group follow a mixed diet; additionally, 27 (45%) in the experimental.

Table 1. Clinical Characteristics of Participants

Demographic variables	Experimental group		Control group	
	Frequency	Percentage	Frequency	Percentage
Age in years				
51-60	26	43.33	32	53.33
61-70	28	46.67	23	38.33
71-80	6	10.00	5	8.33
Gender				
Male	31	51.67	33	55.00
Female	29	48.33	27	45.00
Duration of DM				
Less than 5 years	6	10.00	4	6.67
6-10 years	50	83.33	48	80.00
10-20 years	4	6.67	8	13.33
Associated Illness				
Asthma	26	43.33	28	46.67
Hypertension	30	50.00	30	50.00
No illness	4	6.67	2	3.33
Treatment				

Oral medication	34	56.67	36	60.00
Insulin	26	43.33	24	40.00

Section B: The frequency and percentage distribution of pretest and posttest levels regarding the impact of Buerger Allen exercise on the healing of neuropathic diabetic foot ulcers in the experimental group is highlighted. Figure 1 indicates that in the experimental group, 4 participants (6.67%) experienced good wound healing, 38 participants (63.33%) had

moderate healing, and 18 participants (30%) exhibited poor wound healing during the pre-test. In contrast, the post-test results show that 24 participants (40%) achieved good wound healing, 32 participants (53.33%) had moderate healing, and only 4 participants (6.67%) showed poor wound healing.

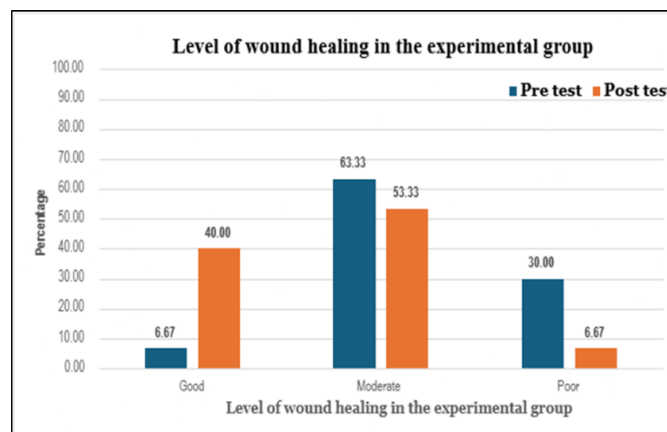


Figure 1. Percentage Distribution of Wound Healing in the Pretest Level and Posttest Level of the Experimental Group

Section C: The frequency and percentage distribution of pretest and posttest levels regarding the effects of Buerger Allen exercise on the healing of neuropathic diabetic foot ulcers in the control group is presented. Figure 2 illustrates that in the control group, 2 individuals (3.33%) exhibited good wound healing, 34 individuals (56.67%) experienced

moderate wound healing, and 24 individuals (40%) had poor wound healing during the pretest. In the posttest, however, 6 individuals (10%) showed good wound healing, 34 individuals (56.67%) continued to demonstrate moderate wound healing, and 20 individuals (33.33%) were classified with poor wound healing.

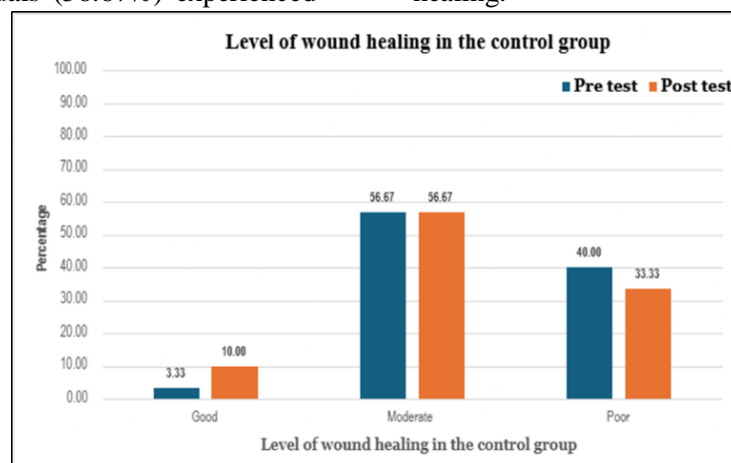


Figure 2. Frequency and Percentage Distribution of Pre-Test Level and Post-Test Level of Effects of Buerger Allen Exercise on the Healing of Neuropathic Diabetic Foot Ulcers in the Control Group

Section D: Level of wound healing in the experimental group. Table 2 shows that in the experimental group, the pretest mean was 22.37 and the posttest mean was 29.02, while the standard deviation of the pretest and posttest were 6.88 and 6.80, respectively. The mean score of the pretest was 22.37 ± 6.88 , and the

posttest was 29.02 ± 6.80 . The mean difference score was 6.65, and the value of 'T' = 5.4754, which is statistically significant at $P < 0.05$. We can infer that there is a significant difference between the pretest and posttest levels of wound healing.

Table 2. Level of Wound Healing in the Experimental Group

Level of wound healing	Mean	S.D	Mean Difference Score	Paired t-test & p-value
Pre test	22.37	6.88	6.65	t= 5.4754
Post test	29.02	6.80		p= 9.41E-07

Section E: The level of wound healing in the control group was assessed. Table 3 indicates that the mean score for the pretest in the control group was 21.82, whereas the mean score for the posttest was 22.93; the pretest standard deviation was 6.22, and the posttest standard deviation was 7.55. The pretest mean score was

recorded as 21.82 ± 6.22 , and the posttest mean score as 22.93 ± 7.55 . The mean difference between the scores was 1.12, with a 'T' value of 0.8232, which is not statistically significant at $P < 0.05$. Thus, we can conclude that there is no significant difference between the pretest and posttest levels of wound healing.

Table 3. Level of Wound Healing in the Control Group

Level of wound healing	Mean	S.D	Mean Difference Score	Paired t-test & p-value
Pre test	21.82	6.22	1.12	t= 0.8232
Post test	22.93	7.55		p= 0.41372

Section F: The comparison of wound healing levels between the experimental and control groups is presented. In Figure 3, the experimental group exhibited a pretest mean of 22.37 and a posttest mean of 29.02, with standard deviations of 6.88 and 6.80, respectively. The average score for the pretest was 22.37 ± 6.88 , while the posttest averaged 29.02 ± 6.80 . The mean difference score was determined to be 0.55, and the 'T' value was calculated as 5.4754, which is statistically significant at $P < 0.05$. This indicates that there is a notable difference between the pretest and

posttest wound healing levels. In the control group, as shown in Figure 3, the pretest mean was 21.82 and the posttest mean was 22.93, with standard deviations of 6.22 and 7.55, respectively. The mean score for the pretest was 21.82 ± 6.22 , and the posttest mean was 22.93 ± 7.55 . The mean difference score here was 0.08, and the 'T' value was 0.8232, which is not statistically significant at $P < 0.05$. This suggests that there is no significant difference in the pretest and posttest levels of wound healing.

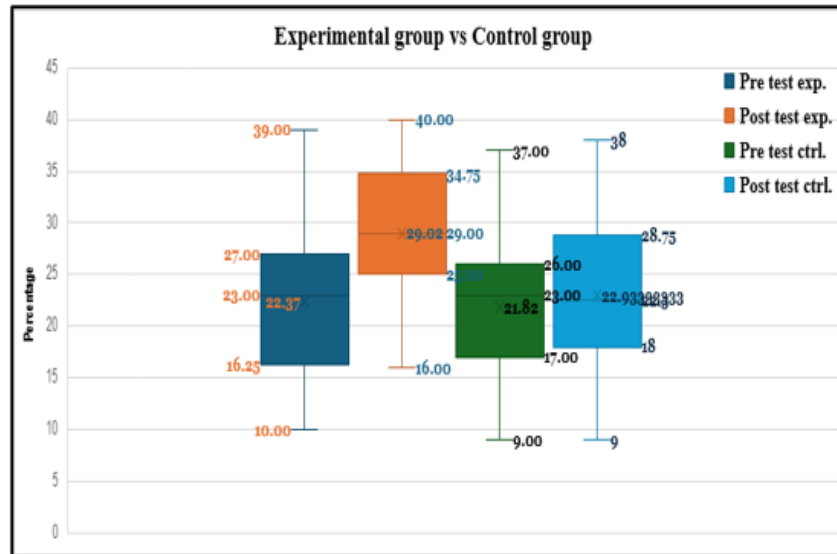


Figure 3. Level of Wound Healing Between the Experimental Group and the Control Group

Section G: An analysis of variance was conducted to evaluate the impact of Buerger Allen exercise on the healing of neuropathic diabetic foot ulcers, taking into account selected demographic factors. In Table 4, it is presented that the experimental group had a pretest mean of 22.37 and a posttest mean of 29.02, with standard deviations for the pretest and posttest being 6.88 and 6.80, respectively. The pretest variance was 47.39, while the posttest variance was 46.25. The 'F' value calculated was 28.3348, indicating a significant

difference between the pretest and posttest levels of wound healing. Additionally, Table 4 reveals that, in the control group, the pretest mean was also 22.37 and the posttest mean was 29.02, with the same standard deviations of 6.88 for the pretest and 6.80 for the posttest. The variance for the pretest was 38.66, whereas for the posttest it was 56.98. The 'F' value is equal to 0.78228, demonstrating that there was no significant difference between the pretest and posttest levels of wound healing.

Table 4. Analysis of Variance of Level of Effects of Buerger Allen Exercise on the Healing of Neuropathic Diabetic Foot Ulcers among the Patients with Selected Demographic Variables.

Level of wound healing	Experimental group			Control group		
	Mean	S. D	Variance	Mean	S. D	Variance
Pre test	22.37	6.88	47.39	21.82	6.22	38.66
Post test	29.02	6.80	46.25	22.93	7.55	56.98
F-value	28.3348			0.78228		
p-value	4.93E-07			3.78E-01		

Discussion

Managing neuropathic diabetic foot ulcers (DFUs) is a complicated and difficult area of diabetes care. Neuropathy, together with inadequate blood flow, results in hindered wound healing, making those with type 2

diabetes especially vulnerable to persistent ulcers, infections, and potential amputations. Conventional treatment methods typically emphasise wound management, glucose control, and infection treatment. Nevertheless, even with these strategies, healing rates for diabetic foot ulcers remain insufficient,

especially in patients suffering from neuropathy. Therefore, investigating additional therapeutic options such as the Buerger-Allen exercise, aimed at boosting peripheral circulation, has gained attention in the treatment of these issues. The Buerger-Allen exercises consist of a series of actions initially created to enhance blood circulation in the extremities. These exercises include alternating the positions of the legs—elevated, dependent, and horizontal—while engaging in gentle muscle contractions. The main goal of these exercises is to increase blood flow to the limbs, particularly in individuals experiencing compromised circulation due to diabetes or peripheral arterial disease. Individuals with diabetic neuropathy frequently face inadequate blood circulation in their legs and feet, leading to slower healing of foot ulcers. This study is based on the hypothesis that enhancing blood circulation through Buerger-Allen exercises can more effectively deliver oxygen and nutrients to the ulcer area, thereby speeding up the healing process. Furthermore, improved circulation may help lower the risk of complications such as infections and ischemia that are often associated with chronic diabetic foot ulcers. **Future Directions:** Additional research is necessary to gain a comprehensive understanding of the range of benefits that Buerger-Allen exercises may provide. Future investigations should include a larger and more varied patient demographic. Examine the long-term impacts of Buerger-Allen exercises on the recurrence of ulcers. Investigate the ideal frequency and duration of the exercises to achieve optimal therapeutic results. Analyse the combination of Buerger-Allen exercises with other advanced treatments, such as offloading devices, negative pressure wound therapy, or sophisticated dressings.

Limitations

Although the findings of this study are encouraging, several limitations should be considered:

Sample Size: The number of participants in this study may be insufficient to apply the findings to a broader population. Larger randomised controlled trials are required to confirm these outcomes.

Follow-Up Duration: The duration of follow-up may have been inadequate to evaluate the long-term impacts of Buerger-Allen exercises on ulcer recurrence or the prevention of subsequent ulcers.

Patient Compliance: The effectiveness of the intervention largely relies on patient adherence. Since the exercises necessitate a daily commitment, the level of adherence may have varied among participants, potentially affecting the results.

Diabetic Control: Although the study accounted for initial blood sugar levels, it is crucial to recognise that inadequate glycemic control could still influence the results, as elevated glucose levels can hinder wound healing regardless of the exercise intervention.

Conclusion

Research investigating the impact of Buerger-Allen exercises on the healing of neuropathic diabetic foot ulcers in individuals with type 2 diabetes indicates that this exercise regimen can considerably improve circulation, enhance tissue oxygenation, and aid in wound healing. The findings suggest that adding Buerger-Allen exercises to the treatment approach for diabetic foot ulcers may result in quicker and more effective healing by boosting peripheral blood flow and lowering the risk of further complications, such as infections or amputations. Moreover, patients who regularly performed Buerger-Allen exercises experienced enhancements in overall foot function and reductions in pain levels, which positively affected their quality of life. These results underscore the potential of this straightforward, non-invasive exercise method as a supplementary therapy for treating diabetic foot ulcers, especially in neuropathic patients who frequently face challenges with poor

circulation. Nonetheless, additional large-scale and long-term research is necessary to validate the effectiveness of Buerger-Allen exercises in a wider patient demographic and to investigate the best frequency and duration of the exercises for optimal benefits in ulcer healing and preventing recurrences.

Acknowledgement

I would like to express my deepest gratitude to Dr Deepak, Director of SIMATS. For giving

Reference

- [1]. Ahmad, A. M., Mohammed, A. A., Khalifassss, W. A., Ali, H. M., & Abdel-Aziz, A., 2024. Effect of Buerger–Allen exercise on wound healing in patients with diabetic foot ulcers: a randomised controlled trial. *Journal of Wound Care*, 33(Sup4a), xci-xcviii.
- [2]. Rushdy, I., Fahim, E. M., & Heggy, E. H., 2021. Impact of buerger-allen exercises on foot perfusion and pain level for diabetic patients' risk with peripheral arterial disease. *Assiut Scientific Nursing Journal*, 9(24.0), 170-181.
- [3]. Thakur, A., Sharma, R., Sharma, S. K., Thakur, K., & Jelly, P., 2022. Effect of buerger allen exercise on foot perfusion among patients with diabetes mellitus: A systematic review & meta-analysis. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 16(2), 102393.
- [4]. Hasaini, A., Muhlisoh, M., & Sukmawaty, M. N., 2023. Effectiveness of Buerger Allen Exercise and Warm Water Foot Soak on Foot Sensitivity Score in A Group of Patients with Type 2 DM. *Indonesian Journal of Global Health Research*, 5(2), 387-398.
- [5]. Radhika, J., Poomalai, G., Nalini, S., & Revathi, R., 2020. Effectiveness of buerger-allen exercise on lower extremity perfusion and peripheral neuropathy symptoms among patients with diabetes mellitus. *Iranian journal of nursing and midwifery research*, 25(4), 291-295.
- [6]. Ahmed Saleh, M., Samir Ahmed, S., & Hussein Bakr, Z., 2024. Effect of Buerger Allen Exercise on Lower Limb Perfusion and peripheral Neuropathy

this great opportunity to conduct a study at his esteemed institution, I would like to thank the Management of SIMATS, Chennai, for rendering continuous support, and I extend my sincere thanks to Dr Vijayalakshmi. R, Principal, Saveetha College of Nursing, SIMATS, Chennai.

Conflicts of Interest

The author declares no conflict of interest.

- among Patients with Peripheral Vascular Diseases. *Egyptian Journal of Health Care*, 15(1), 1248-1261.
- [7]. Srivatsan, M., Subramanian, S. S., Vishnuram, S., Razali, H., Fatima, I., & Alhalaiqa, F., 2024. Effectiveness of low-level laser therapy with Buerger Allen exercise versus LIPUS with Buerger Allen exercise for diabetic foot ulcer.
 - [8]. Bhuvaneshwari, S., & Tamilselvi, S., 2018. A study to assess the effectiveness of Buerger Allen exercise on lower extremity perfusion among patients with type 2 diabetes mellitus in Saveetha Medical College and Hospital in Chennai. *International Journal for Advance Research and Development*, 3(9), 15-20.
 - [9]. Krosuru, C., & Darshini, N. P., 2024. Effectiveness of Buerger Allen Exercises on Lower Extremity Perfusion among patients with Type 2 Diabetes Mellitus in selected hospitals at Guntur District, Andhra Pradesh. *A and V Pub Journal of Nursing and Medical Research*, 3(4), 136-140.
 - [10]. Adel Ebada El Sayed, R., Nabil Abd Elsalam, S., & Mohamed Elmetwaly, R., 2021. Effect of Buerger-Allen Exercise on Lower Extremities Perfusion among Patients with Type 2 Diabetes Mellitus. *Egyptian Journal of Health Care*, 12(2), 555-572.
 - [11]. GV, V. P. S., & Maiya, G. R., 2021. Coverage, utilization, and impact of Ayushman Bharat scheme among the rural field practice area of Saveetha Medical College and Hospital, Chennai. *Journal of Family Medicine and Primary Care*, 10(3), 1171-1176.
 - [12]. Ajith, M., & Vijayalakshmi, R. (2024, December 27). A study to assess the effectiveness of

structured teaching program on knowledge on hand washing among school children at selected school. *Texila International Journal of Public Health*. Advance online publication. <https://doi.org/10.21522/TIJPH.2013.SE.25.01.Art018>

[13]. Shyamala, M. A., Ali, A., & Ajith, M., 2024. Depression and Quality of Life Among Haemodialysis Patients. *Journal of Pharmacy and Bioallied Sciences*, 16(3), S2880-S2882.

[14]. Wardani, E. M., Nugroho, R. F., Setiyowati, E., Ainiyah, N., Bistara, D. N., & Hasina, S. N., 2023. Diabetic foot spa, bueger's allen exercise and music therapy on foot sensitivity, the ankle brachial index and sleep quality for diabetes mellitus in Indonesia. *Bangladesh Journal of Medical Sciences*, 22(3), 536-544.

[15]. Abbass, M., Rehman, M., Emaan, I., Shaukat, U., Farooq, S. U. R., & ur Rehman, M. M., 2024. Comparative Effect of Buerger-Allen Exercise and Intraneural Facilitation on Lower Extremity Perfusion and Peripheral Neuropathy Symptoms Among Patients with Type II Diabetes Mellitus. *Journal of Health and Rehabilitation Research*, 4(2), 1511-1517.

[16]. Anggraeni, H. N., Vitaliati, T., & Cahyono, H. D., 2023. The Effect of Buerger Allen Exercise on Perfusion of Peripheral Tissues in Patients with

Diabetes Mellitus: Literature Reviews. *Journal Kesehatan Manarang*, 9(1), 42-51.

[17]. Widiastuti, H. P., Paongan, R., Setiani, D., Arsyawina, A., Pramono, J. S., & Hilda, H., 2024. Buerger-Allen exercises' effectiveness for improving lower limb circulation. *Healthcare in Low-resource Settings*.

[18]. Paluchamy, T., Steni, D. S., & Stephen, S., 2024. Effect of green tea mouthwash on chemotherapy-induced oral mucositis in cancer patients. *Journal of Chemical Health Risks*, 14(1). <https://doi.org/10.60829/jchr.2024.1103158>

[19]. Deepika, D., Rajavarshini, & Madaswamy, R., 2024. Effectiveness of Camphor Oil Application on Reduction of Joint Pain among Post-Menopausal Women at Selected Rural Areas. *Texila International Journal of Public Health*, Summer Special Edition. Advance online publication. <https://doi.org/10.21522/TIJPH.2013.SE.24.02.Art012>

[20]. Thenmozhi, P., Dineshkumar, P., Bhuvaneswari, G., Mary Minolin, T., & Tamilselvi, S., 2025. Thoracic squeezing on airway secretion and respiratory parameters in mechanically ventilated patients: An interventional study. *Journal of Education and Health Promotion*, 14(1), 69. https://doi.org/10.4103/jehp.jehp_695_24