

# A STUDY TO ASSESS THE EFFECTIVENESS OF BUERGER'S ALLEN EXERCISE ON LOWER EXTREMITY PERFUSION AMONG PATIENT WITH DIABETES MELLITUS ADMITTED IN A SELECTED HOSPITAL, BANGALORE

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## **Abstract-**

### **Background:**

According to the World Health Organization (WHO) report, India today heads the world with over 32 million diabetic patients and this number is projected to increase to 79.4 million by the year 2030. Recent surveys indicate that diabetes affects a staggering 10-16% of urban population and (5-8%) of rural population in India now. There is very little data on the level of awareness and prevalence about diabetes in developing countries like India. It is estimated that there are currently 285 million people with diabetes worldwide and this number is set to increase to 438 million by the year 2030. The management of inadequate tissue perfusion in the lower extremity is similar to the management of peripheral artery disease since the decrease perfusion of the lower extremity cause peripheral artery disease. In the medical set up the treatment modalities focus on anti-platelet, anti-coagulations, antibiotic and revascularization procedure such as angioplasty, vascular bypass grafting, atherectomy and thrombectomy. To improve the blood circulation of the lower extremity exercise has been considered as one of the most effective non-pharmacological management among patient with type 2 diabetes mellitus. Berger Allen exercise is one of the most common practice exercises in diabetic patient to drain engorged vessel by using postural changes and stimulated peripheral circulation by modulating gravity and applying muscle contraction for improving the lower extremity perfusion among diabetic patients which relieve the symptoms in patients with lower limbs arterial insufficient. Therefore, in order to promote the quality-of-life barterable exercise is needed among patient with type II diabetes mellitus.

### **Objectives of the study:**

- To assess the lower extremity perfusion among patients with diabetes mellitus.
- To evaluate the effectiveness of Buerger's Allen exercise on lower extremity perfusion among the patients with diabetes mellitus
- To find out the association between the lower extremity perfusion with selected demographic variables among patients with diabetes mellitus.

### **Methods:**

A quantitative approach with one group pre-test post test design pre-experimental design was appropriate for the study. The sample consisted of 30 Diabetes mellitus patients. The sample was selected using nonprobability purposive sampling technique. The tools used for the study was Modified inlows 60 seconds diabetic foot scale. Both the pre interventional and post interventional lower extremity perfusion level were assessed by using modified inlows 60 seconds foot scale. The Buerger Allen exercise was administered for 5 consecutive days for twice a day. The data was Analysed using both descriptive and inferential statistics.

### **Results:**

The result of the study demonstrated that the mean post-test score is (7.1s%) lower than pre-test mean (13.83%) score. The computed paired 't' test value is  $p < 0.001$ . This reveals that there is significant difference between the pre-test and post test scores with regard to lower extremity perfusion at 0.001 level of significance.

### **Interpretation and conclusion:**

The result of the study shows that lower extremity perfusion of diabetes mellitus patients was increased after administration of Buerger's Allen exercise. Hence, it is concluded that the Buerger Allen exercise were found to be effective in improving the lower extremity perfusion among diabetes mellitus patients in selected hospital.

**Key words-** Buerger Allen exercise, effectiveness; lower extremity perfusion.

## **INTRODUCTION:**

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. It is characterized by fasting and post prandial

hyperglycaemia with plasma glucose level that are above defined limits during oral glucose tolerance testing or random blood glucose measurement.

Type 1 Diabetes mellitus is the absolute deficiency of insulin due to autoimmune destruction of beta cells. Type 2 Diabetes mellitus occurs due to insulin resistance and relative insulin deficiency.

Acute complications of Diabetes Mellitus include diabetic ketoacidosis (DKA) and non-ketosis hyper-osmolar state (NKHS) and Hypoglycaemia. While the first is seen primarily in individuals with type 1 DM, the latter is prevalent in individuals with type 2 DM.

Chronic complications can be divided into vascular and nonvascular complications. The vascular complications are further subdivided into microvascular (retinopathy, neuropathy, and nephropathy) and macro vascular complications (coronary artery disease, peripheral vascular disease, and cerebrovascular disease). Nonvascular complications include problems such as gastroparesis, sexual dysfunction, and skin changes. As a consequence of its chronic complications, DM is the most common cause of adult blindness, a variety of debilitating neuropathies, and cardiac and cerebral disorders. Treating the complications of diabetes costs more than controlling the disease. <sup>4</sup>

Peripheral arterial disease (PAD) is narrowing or blockage of arteries with accumulation of fatty tissues and plaque, known as atherosclerosis commonly it is referred as poor circulation of blood flow to arms and legs. It often is used as a synonym for "Peripheral Vascular Disease". Commonly, the disease affecting the lower limb. Type 2 diabetes mellitus is a major factor causing peripheral vascular resistance which leads to PAD. It is a "silent killer" disease. The Buerger's Allen exercise is for improving the lower extremity perfusion in diabetic patients. <sup>5</sup>

Buerger's Allen exercise helps in drain the blood from major arteries like popliteal artery, anterior tibial artery, perineal and dorsalis Pedit's artery. Elevation of extremity counter act gravitational pull promotes venous return and prevents venous stasis, enhances the venous circulation especially in the foot and equally distributes the blood flow all over the body.

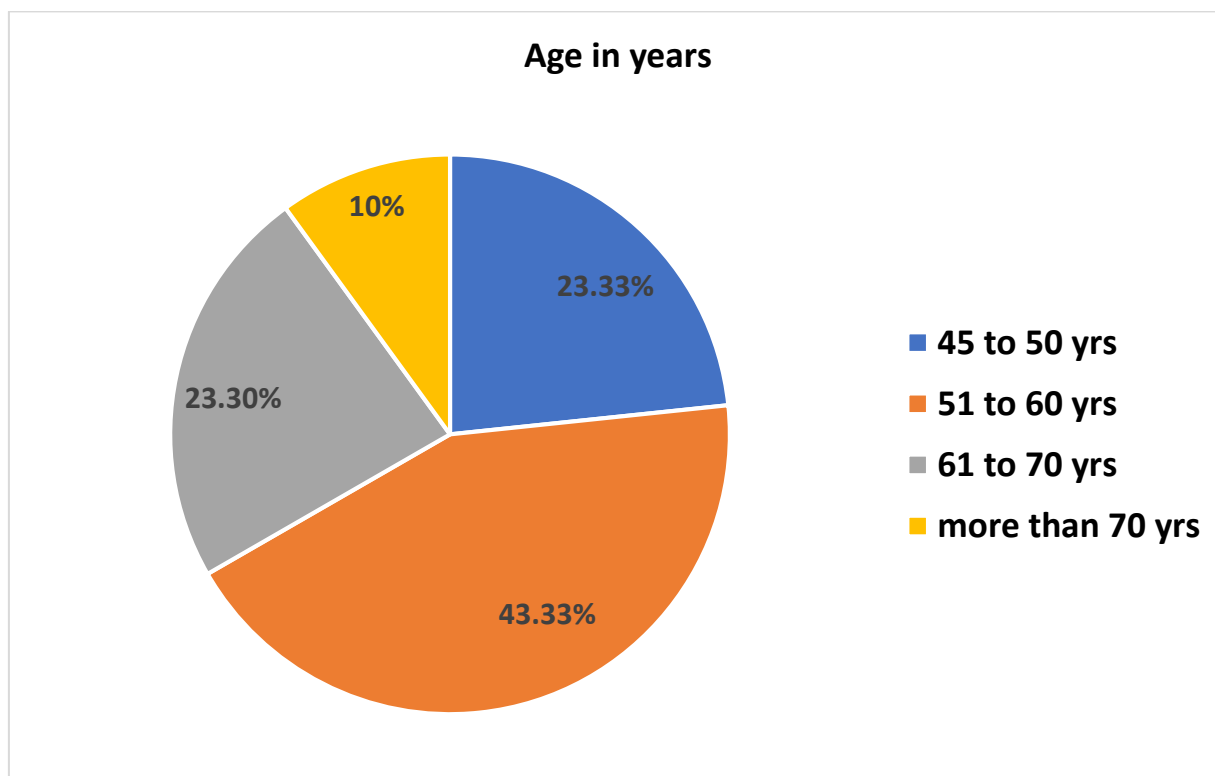
### Methodology

A quantitative approach with one group pre-test post-test design pre-experimental design was appropriate for the study. The sample consisted of 30 diabetes mellitus patients. The sample was selected using nonprobability purposive sampling technique. The tools used for the study was Modified inlows 60 seconds diabetic foot scale. Both the pre interventional and post interventional lower extremity perfusion level were assessed by using modified inlows 60 seconds foot scale. The Beurger Allen exercise was administered for 5 consecutive days for twice a day. The data was analysed using both descriptive and inferential statistics.

### Results

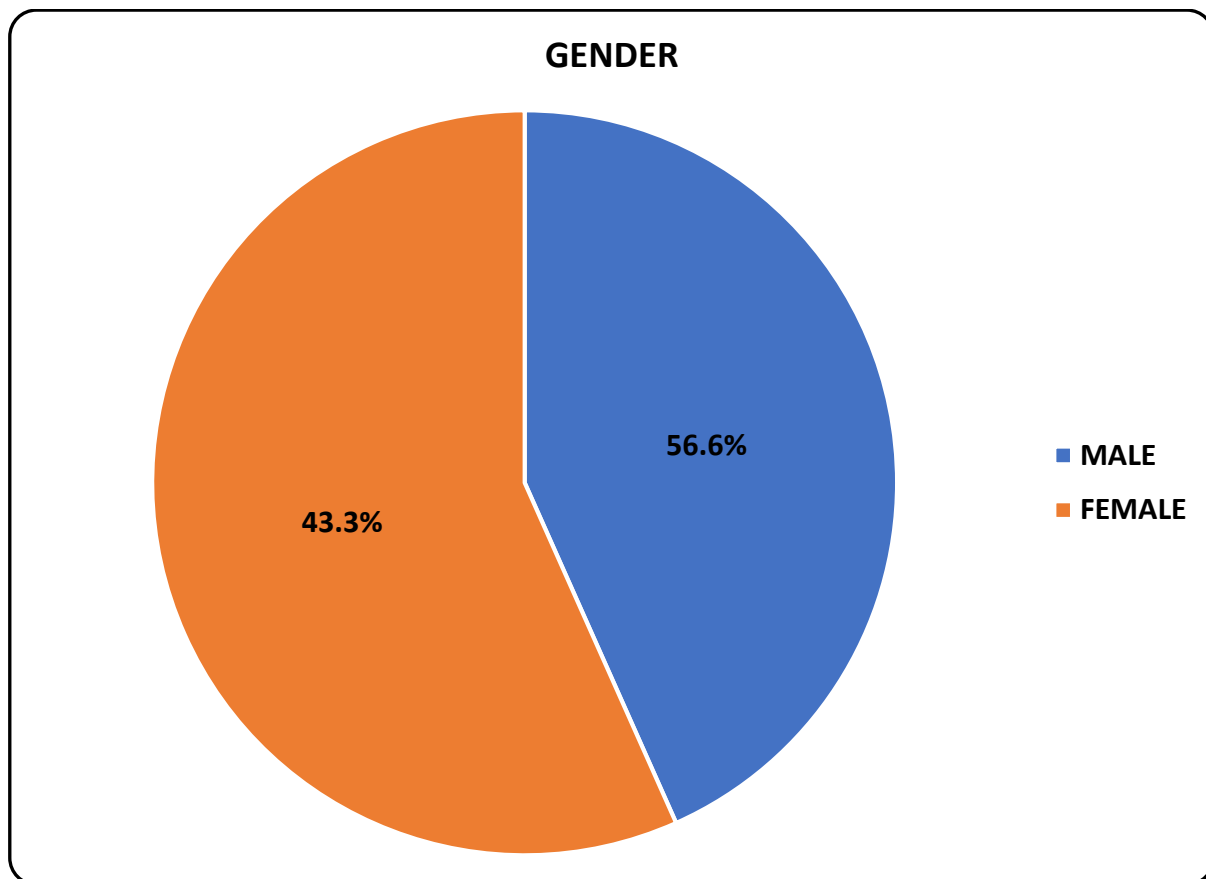
#### Section 1: Distribution of baseline characteristics of the subjects

This section deals with the description of baseline characteristics of 40 subjects in terms of frequency and percentage such as age, gender, habits, types of job, comorbidities, duration of diabetes mellitus, compliance of antidiabetic medication, complication and HbA1c level admitted in St. Martha's hospital.



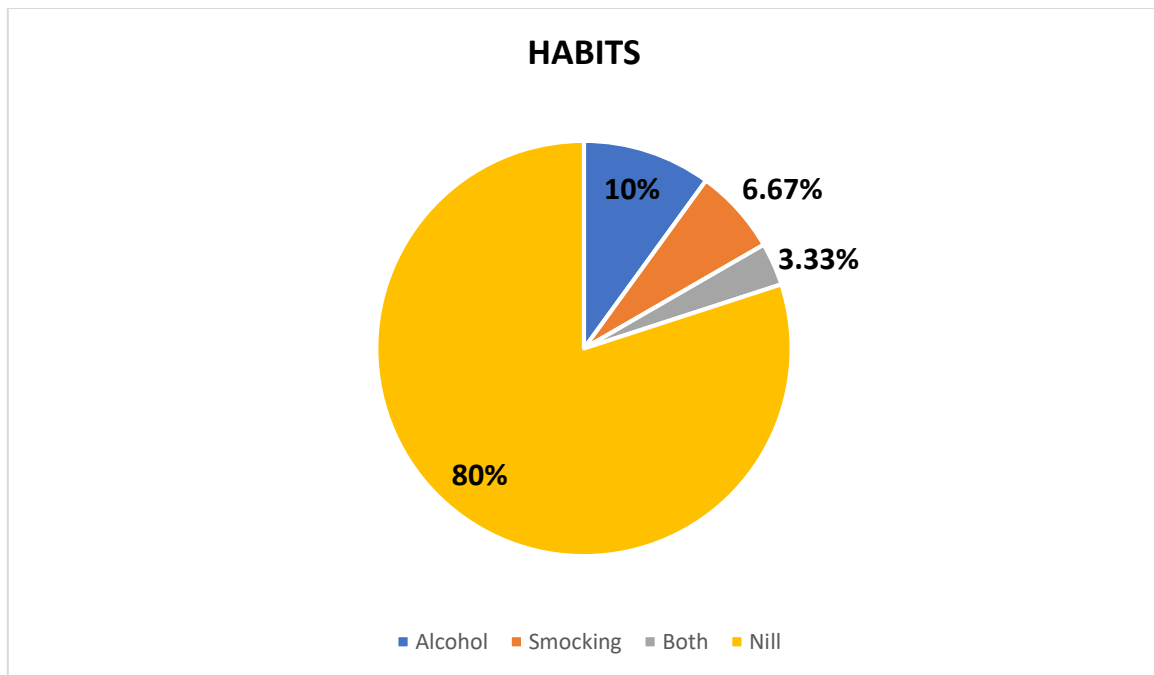
**Figure 1: Distribution of subjects according to the age**

Figure 1 indicates that the majority, 43.33% (13) of the subjects belonged to the age group of 51-60 years and only 10% (3) of the subjects were above 70 years.



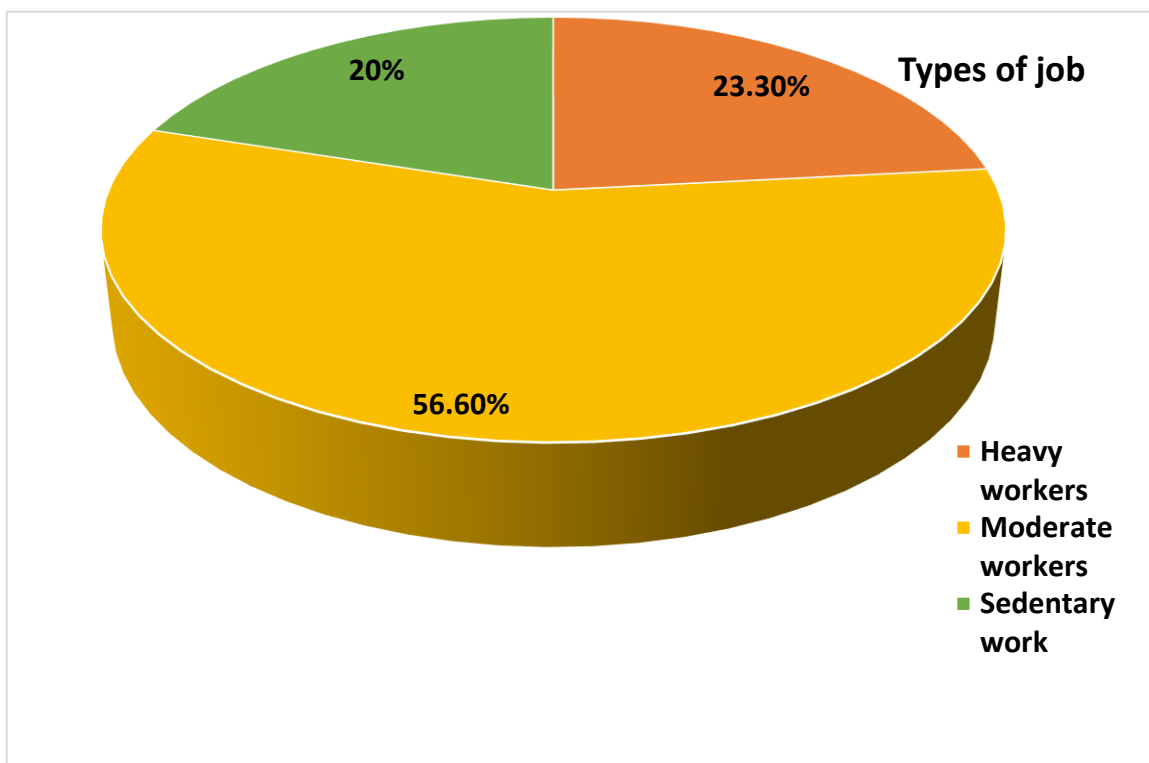
**Figure 2: Distribution of subjects according to the Gender**

Figure 2 indicates that 56.65% (17) were male and 43.3% (13) were female



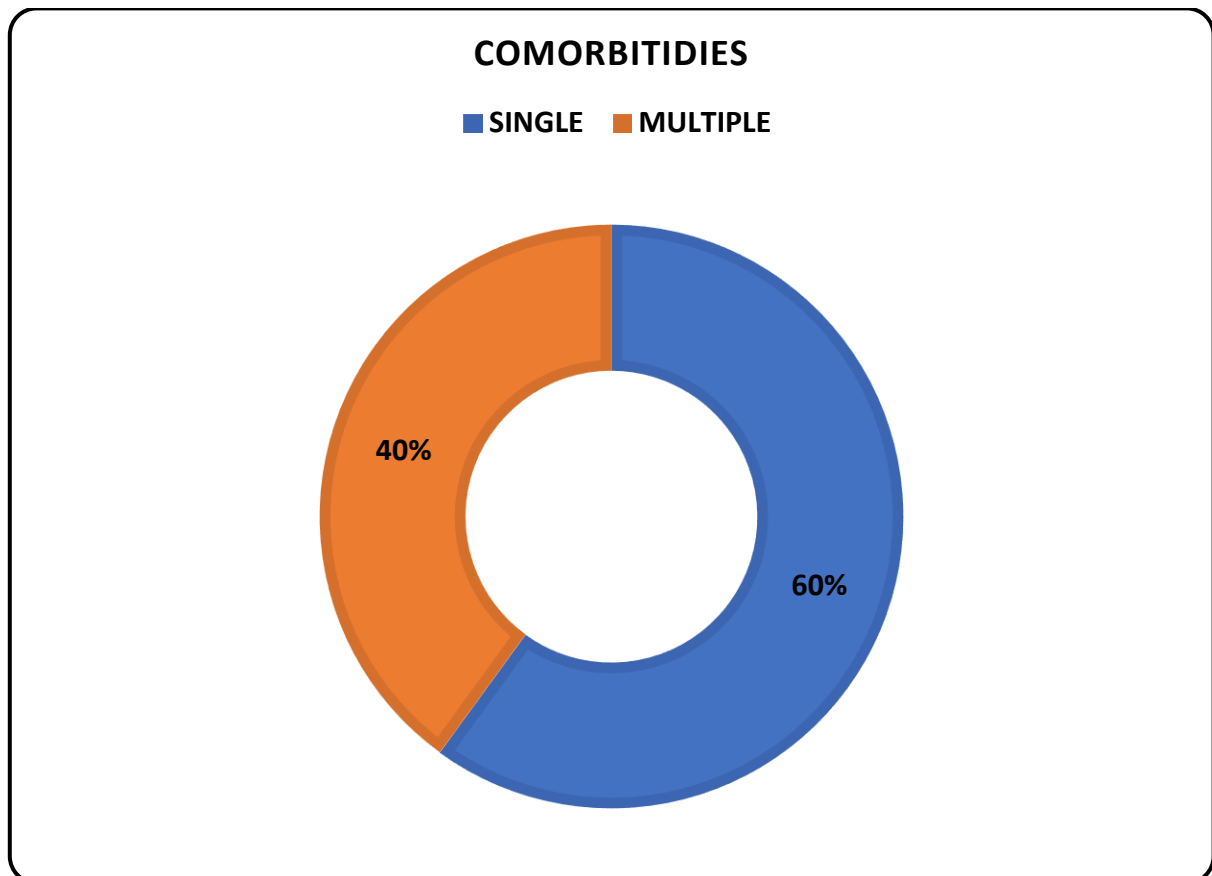
**Figure 3: Distribution of subjects according to the habits**

Figure 3 shows that 80% (24) of the subjects had no habits and only 3.33% (1) of subjects had both habits of smoking and alcoholism.



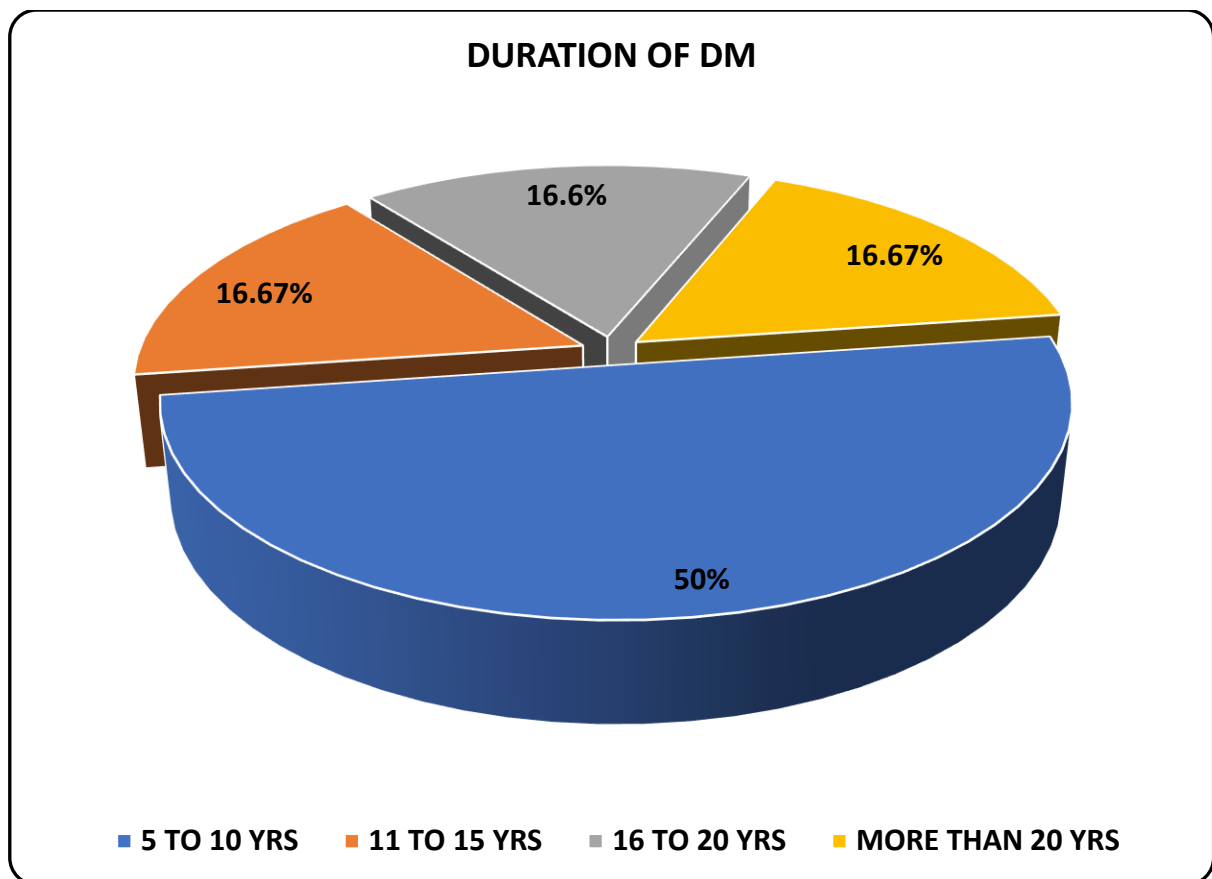
**Figure 4: Distribution of subjects according to the types of work**

Figure 4 shows that 56.6% of the subjects were moderate workers and only 20% (6) of the subjects were sedentary workers



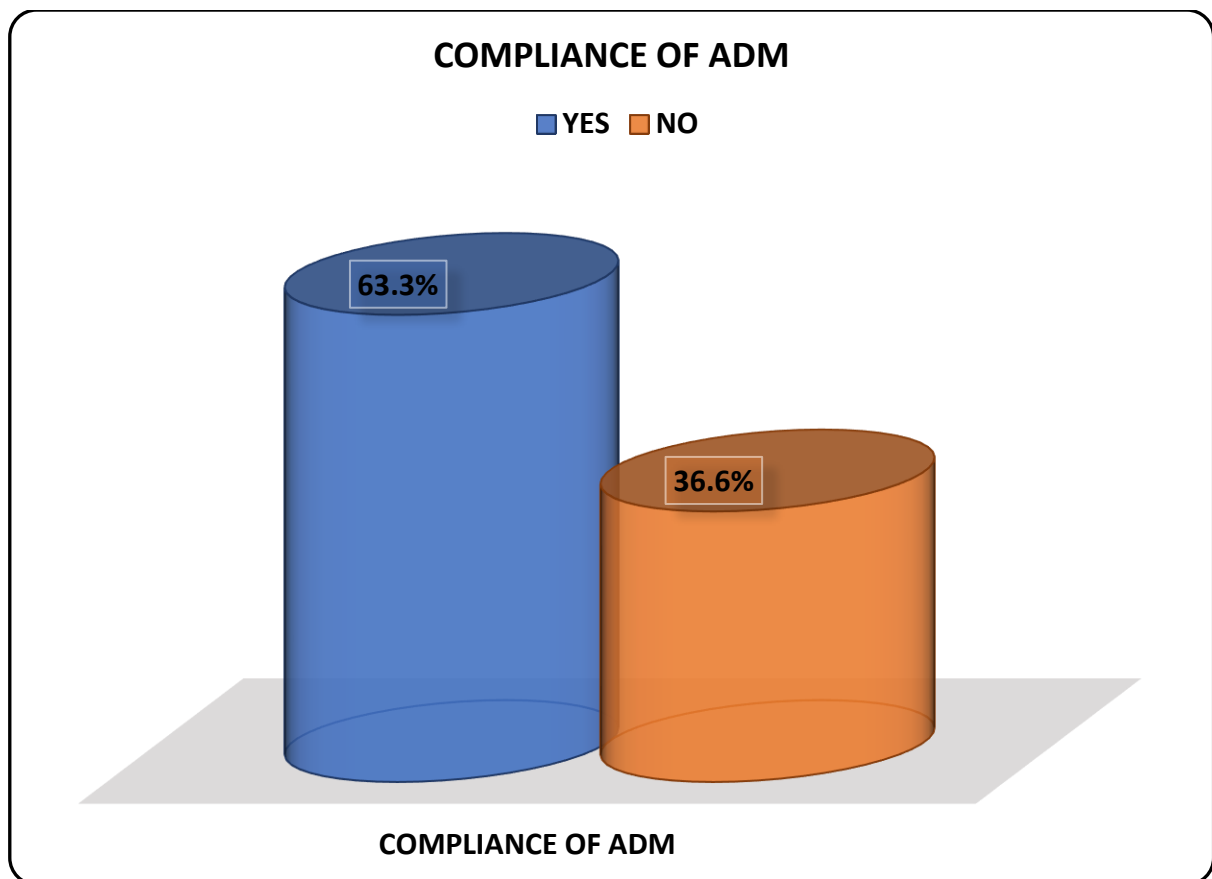
**Figure 5: Distribution of subjects according to the comorbidities**

Figure 5 shows that 60% (18) of the subjects had multiple comorbidities and 40% (12) of the subjects had single comorbidities.

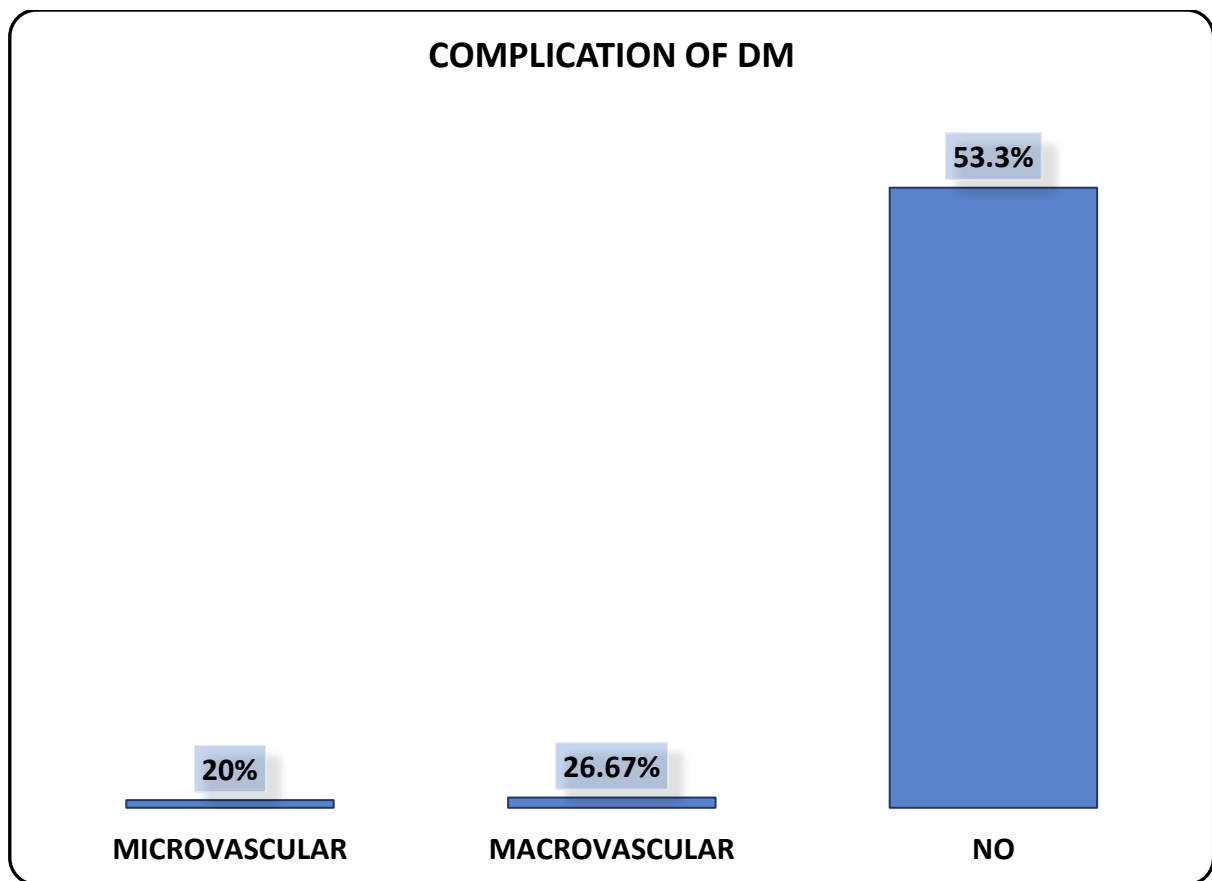


**Figure 6: Distribution of subjects according to the duration of diabetes mellitus**

Figure 6 shows that half of the subjects, (50%) of the subjects had duration of diabetes mellitus between 5 to 10 years.



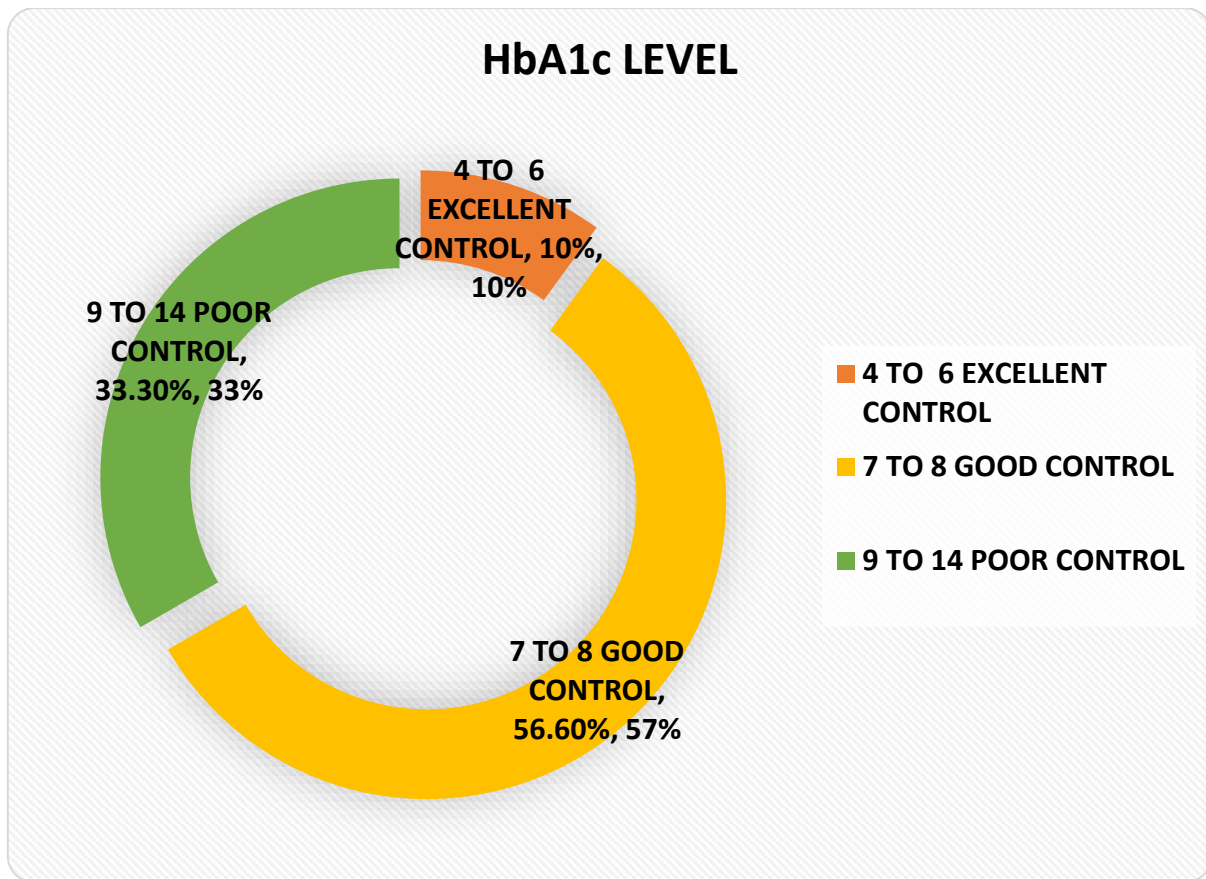
**Figure 7: Distribution of subjects according to the compliance of antidiabetic medication**  
Figure shows that 63.3% (19) had compliance of antidiabetic drugs and 36.6% (11) had noncompliance.



**Figure 8: Distribution of subjects according to the complication of diabetes mellitus**

Figure 8 shows that 50.3% (16) of the subjects had no documented complication of diabetes mellitus.





**Figure 9: Distribution of subjects according to the HbA1c level**

Figure 9 shows that 56.6% (17) of the subjects had good control and only 10% (3) subjects had excellent control of blood glucose level.

**SECTION 2: Distribution of subjects according to scores of lower extremity perfusion**

This section deals with description on lower extremity perfusion in the terms of frequency and percentage. It was measured before and after administration of Beurger Allen exercise by using modified inflows 60 seconds diabetic foot scale.

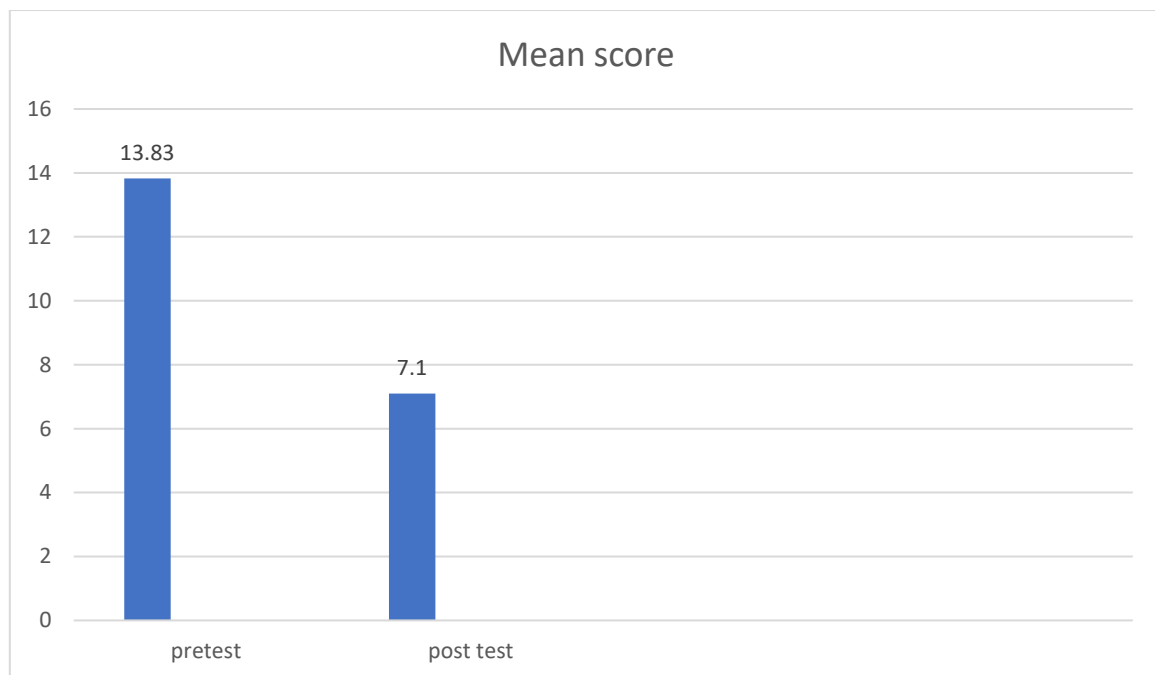
N=30

Modified inflows 60 seconds foot score				
	Pre-test score		Post test score	
	Frequency	Percentage	Frequency	Percentage
0-6 good perfusion	0	0	17	56.6%
7-12 slightly poor perfusion	11	36.6%	13	43.33%
13-19 poor perfusion	18	60%	0	0
20-25 very poor perfusion	1	3.33%	0	0

**Frequency and percentage distribution of lower extremity perfusion**

Data from the table shows that during pre-intervention assessment, the majority of the subjects lower extremities perfusion were [ 18 (60%)] had poor perfusions, were 11 (36.6%) of subjects had slightly poor perfusion and only 1 (3.33%) were very poor perfusion. Whereas post intervention assessment shows that most of the subjects, [ 17 (56.6%)] had good perfusion and 13 (43.33%) of subjects had slightly poor perfusion.

**Figure 12: Distribution of mean score of lower extremity perfusion**



The above figures show that, post intervention mean scores were lesser ( $M=7.1$ ) compared to that of pre intervention mean score ( $M=13.83$ ).

### SECTION 3: Description of effectiveness of Burger Allen exercise on lower extremity perfusion among subjects.

In order to find the significance association between pretest and posttest lower extremity perfusion score, paired 't' test was computed and the data is presented in the below table. To test the statistical significance the following research hypothesis was stated.

$H_1$ : There will be a significant difference between the pre-test and post test scores on the lower extremity perfusion among patients with diabetic mellitus at 0.05 level of significance

TIME	N	LOWER EXTREMITY PERFUSSION RATE		P-VALUE <sup>¥</sup>
		MEAN	STD.DEV	
PRE BUERGER-ALLEN EXERCISE	30	13.83	3.37	<0.001 S
POST BUERGER-ALLEN EXERCISE	30	7.1	2.23	

N=30

<sup>¥</sup>Paired Sample T-test

S=Significance

The table depicts that, post intervention mean score is lesser ( $M=7.1$ ,  $SD: 3.37$ ) compared to the pre interventional mean score ( $M=13.83$ ,  $SD: 2.23$ ). Paired T test value is computed and the obtained p value is less than 0.001. Hence concluded that there was a statically significant improvement in lower extremity perfusion among diabetes patients after administration of Burger Allen exercise. Hence the research hypothesis  $H_1$  is accepted.

### Section 4: Association between pretest lower extremity perfusion score and selected demographic variables.

In order to determine the association of peripheral perfusion with selected demographic variable, One-way ANOVA; <sup>€</sup>Independent Sample T-test were computed and the data is presented in table below. To test the association between lower extremity perfusion and selected demographic variable, the following research hypothesis was stated.

$H_2$ =There will be significant association between the pretest lower extremity perfusion and the selected demographic variables

**Table: Association between pretest lower extremity perfusion score and selected demographic variables**

PARAMETERS	N	LOWER EXTREMITY PERFUSION RATE - PRE-EXERCISE		P-VALUE <sup>¥</sup>
		MEAN	SD	
<b>AGE</b>				
45 TO 50 YRS	7	15	3.74	0.455
51 TO 60 YRS	13	13.39	3.2	
61 TO 70 YRS	7	12.71	3.64	
MORE THAN 70 YRS	3	15.67	2.52	
<b>GENDER<sup>€</sup></b>				
FEMALE	17	14.29	3.77	0.408
MALE	13	13.23	2.8	
<b>HABITS<sup>€</sup></b>				
PRESENT	6	12.50	3.39	0.287
ABSENT	24	14.16	3.35	
<b>TYPEOFJOB</b>				
HEAVY WORKERS	7	11.86	2.48	0.209
MODERATE WORKES	17	14.35	3.79	
SEDENTARY WORKERS	6	14.67	2.34	
<b>COMORBITIDIES<sup>€</sup></b>				
MULTIPLE	12	14.33	2.87	0.571
SINGLE	18	13.5	3.71	
<b>DURATIONOFDM</b>				
11 TO 15 YRS	5	10.4	3.13	0.058
16 TO 20 YRS	5	14	1.87	
5 TO 10 YRS	15	14.27	3.28	
MORE THAN 20 YRS	5	15.8	3.35	
<b>COMPLIANCEOFADM<sup>€</sup></b>				
YES	19	13.47	3.61	0.452
NO	11	14.46	2.98	
<b>COMPLICATIONOFDM</b>				

<b>MACROVASCULAR</b>	8	14.88	3.8	
<b>MICROVASCULAR</b>	6	12.33	3.98	0.390
<b>NO</b>	16	13.88	2.92	
<hr/>				
<b>HBA1CLEVEL</b>				
<b>4 TO 6 EXCELLENT C~L</b>	3	15.33	3.06	
<b>7 TO 8 GOOD CONTROL</b>	17	13.41	2.96	0.646
<b>9 TO 14 POOR CONTROL</b>	10	14.1	4.23	

¥One-way ANOVA; €Independent Sample T-test

The data presented in the table shows that the demographic variables had shown that statistically no significant association with lower extremity perfusion among subjects at  $p > 0.005$ . So, research hypothesis was rejected. Concluded that there is no association between the lower extremity perfusion and demographic variables.

### Section I: Distribution of baseline characteristics of the subjects.

The findings of the study revealed that, a majority 17 (43%) of the subjects belonged to the age group of 51 to 60 years and only 3 (10%) of subjects were in age group more than 70 years and 17 (57%) were female. A similar study conducted in Coimbatore among 60 diabetes mellitus patients revealed that 10 (33%) belonged to 51 to 55 years and 12 (40%) of subjects belonged to age group of 56 to 60 years.

Gender distribution revealed that majority 17 (57%) of subjects were female. A similar study conducted in saveetha medical college in Chennai among 60 diabetes mellitus patients shows 19 (63.3%) of subjects were female. Among the subject 24 (80%) of the subjects had no habits. Probably the reason of sample was female in the present study.

About 17 (56.6%) of the subjects were moderate workers and only 20% (6) subjects were sedentary workers. Study revealed that 60% (18) of the subjects had multiple comorbidities and 12 (40%) subjects had single comorbidities.

The present study shows that 15 (50%) of the subjects were duration of diabetes mellitus between 5 to 10 years and 19 (63.3%) had compliance of antidiabetic drugs and 36.6% (11) had noncompliance and 50.3% (16) of the subjects had no complication of diabetes mellitus. About 17 (57%) of the subjects had good control of blood glucose level and only 10% (3) of the subjects had excellent control.

The same study showed that the duration of diabetes mellitus majority shows 5 to 10 years (53.3%). This study finding similar to the findings of present study.

### Section II: Distribution of subjects according to score of lower extremities perfusion

The lower extremity perfusion score measured before and after administration of Beurger Allen exercise by using modified inlows 60 seconds foot scale. With regard to the pretest modified inlows score, the analysis of present study revealed that majority of the diabetes subject's lower extremities perfusion was 18 (60%) of subjects had poor perfusions, 11 (36.6%) of subjects had slightly poor perfusion and only 1 (3.33%) of subjects had very poor perfusion and none of the subjects were found good perfusion. Whereas posttest assessment shows that most of the patients 17 (56.6%) of subjects had good perfusion and 13 (43.33%) of subjects had slightly poor perfusion. None of the subjects were found to be poor perfusion and very poor perfusion. From the present study, it is evident that the post intervention mean scores were lesser ( $M=7.1$ ) compared to the pre intervention mean score ( $M=13.83$ ).

This finding is consistent with that of a study conducted to assess the effectiveness of Beurger Allen exercise on lower extremity perfusion among patients with type 2 diabetes mellitus in selected hospital at Kanyakumari district. This study shows that in the pretest 14(43.3%) had inadequate level of lower extremity perfusion which was measured by using modified inlows 60 seconds diabetic foot scale 16 (54.3%) of the subject had severely inadequate poor perfusion, none of them had adequate and moderate adequate perfusion. After the Beurger Allen exercise level of lower extremity perfusion was improved 13 (43.3%) of subjects had adequate perfusion and 17 (56.7%) had moderately adequate perfusion and none of them had inadequate and severely inadequate perfusion. This finding is similar to the finding of the present study.

### Section III: Description of effectiveness of Beurger Allen exercise on lower extremity perfusion among subjects.

The findings of the study demonstrated that the post intervention mean score is lesser ( $M=7.1$ ,  $SD: 3.37$ ) compared to the pre interventional mean score ( $M=13.83$ ,  $SD: 2.23$ ). Paired T test value is computed and the obtained p value is less than 0.001. This reveals that there is significant difference between pre test and post test scores of lower extremity perfusion at a 0.001 level of significance. Hence concluded that there was a statically significant improvement in lower extremity perfusion among diabetes patients after administration of Beurger Allen exercise.

This finding is consistent with that of a study conducted to assess the effectiveness of Beurger Allen exercise on lower extremity perfusion among patients with type 2 diabetes mellitus in saveetha medical college and hospital Chennai among 60 patients. It shows that post interventional mean score was greater ( $M:0.9$ ,  $SD: 0.18$ ) compared to pre interventional mean score ( $M: 0.7$ ,  $SD:$

0.11). The t value is (2.583). concluded that there was a statically significant improvement in lower extremity perfusion among diabetes patients after administration of Buerger Allen exercise, which is similar to present study findings.

#### **Section IV: Association between lower extremity perfusion and demographic variables**

The findings of the study revealed that age of the subjects, gender, habits, types of work, comorbidities, duration of diabetes mellitus, compliance of antidiabetic medication and complication and HbA1c level shown statistically no significant association with lower extremity perfusion among subjects at  $p>0.005$ .

#### **CONCLUSION:**

The findings of the study revealed that the Buerger allen exercise is effective in improving the peripheral perfusion among patients with diabetes mellitus. Thus, study suggested that Buerger Allen exercise is a complimentary alternative therapy that helps the parents, family members and nurses for improving the peripheral circulation, in a cost-effective way without any complication. As this method can be performed for the elderly by themselves or by care giver, it can be recommended in health programs for them. Further comparative study could be conducted to evaluate the effectiveness of Buerger Allen exercise with other non-pharmacological measure and alternative therapy.

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#### **REFERENCES:**

1. Muninarayana C, Balachandra G, Hiremath SG, Iyengar K, Anil NS. Prevalence and awareness regarding diabetes mellitus in rural Tamaka, Kolar. *International journal of diabetes in developing countries*. 2010 Jan;30(1):18.
2. Lamkang MT. Mrs. Aruna, S and Mrs. Mangala Gowri, P. 2017. "Effectiveness of buerger allen exercise on level of lower extremity perfusion among patient with type2 diabetes mellitus. saveetha medical college and hospital", *International Journal of Development Research*.;7(08):14723-6.
3. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes care*. 2009 Jan 1;32(Supplement\_1):S62-7.
4. Lewis 2011. *Medical surgical Nursing publishers g, New Delhi; Elsevier*.
5. Baby B. A Study to Assess the Effectiveness of Buerger Allen Exercise on Lower Extremity Perfusion among Diabetes Mellitus patients admitted in Selected Hospital at Coimbatore (Doctoral dissertation, Ellen College of Nursing, Coimbatore).
6. Lewis CS. *Cardiovascular Pathologies. Mosby's Pathology for Massage Therapists-E-Book*. 2017 Aug 24:231.
7. Mellitus D. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2005 Jan 1;28(S37): S5-10.
8. Ashish A, Shah A, Pandey SS. Interaction between oxidative stress and diabetes: a mini-review. *J Diabetes MetabDisord Control*. 2020;7(2):58-61.
9. Silvy Grace B, Soma Sundaram I. Evaluation of Vascular Complications in Patients with Type 2 Diabetes Mellitus at a South Indian Tertiary Care Hospital. *Age (Years)*.;35:35-50
10. Vijayarathi M. A study to assess the effectiveness of Buerger Allen exercise on wound healing process among the diabetic foot ulcer patients admitted in diabetology department at Rajiv Gandhi Government General Hospital, Chennai (Doctoral dissertation, College of Nursing, Madras Medical College, Chennai)
11. Priya N. Effectiveness of Buerger Allen exercise on levels of lower extremity perfusion among patients with selected non-communicable diseases NCDs admitted at Sri Narayani Hospital and Research Centre, Vellore (Doctoral dissertation, Sri Narayani College of Nursing, Vellore).
12. Sasi RK, Islam R, Sunil A, Markose A. Lower Extremity Perfusion among Patient with Type 2 Diabetes Mellitus in a Tertiary Care Hospital, Kochi. *Indian Journal of Public Health Research & Development*. 2020 Jan 1;11(1).
13. Polit DF, Hungler BP *Nursing Research principles and methods*, Philadelphia: J.B Lippincott Company,1999.
14. von Bertalanffy L. An outline of general system theory. *Emergence: complexity and organization*. 2008 Apr 1;10(2):103-24.
15. Hiatt WR, Hoag S, Hamman RF. Effect of diagnostic criteria on the prevalence of peripheral arterial disease: the San Luis Valley Diabetes Study. *Circulation*. 1995 Mar 1;91(5):1472-9.
16. Osmundson PJ, Chesebro JH, O'Fallon WM, Zimmerman BR, Kazmier FJ, Palumbo PJ. A prospective study of peripheral occlusive arterial disease in diabetes. II. Vascular laboratory assessment. *Mayo Clinic Proceedings* 1981 Apr 1 (Vol. 56, No. 4, pp. 223-232).
17. Vigilance JE, Reid HL. Glycaemic control influences peripheral blood flow and haemorheological variables in patients with diabetes mellitus. *Clinical hemorheology and microcirculation*. 2005 Jan 1;33(4):337-46.
18. Brownrigg JR, Hinchliffe RJ, Apelqvist J, et al, International Working Group on the Diabetic Foot (IWGDF). Effectiveness of bedside investigations to diagnose peripheral artery disease among people with diabetes mellitus: a systematic review. *Diabetes/metabolism research and reviews*. 2016 Jan. 3
19. Celen YZ, Zincirkeser S, Akdemir I, et al. Investigation of perfusion reserve using 99Tcm-MIBI in the lower limbs of diabetic patients. *Nuclear medicine communications*. 2000 Sep 1;21(9):817-22.

20. Stansberry KB, Shapiro SA, Hill MA, McNitt PM, Meyer MD, Vinik AI. Impaired peripheral vasomotion in diabetes. *Diabetes Care*. 1996 Jul 1;19(7):715-21.
21. Kizu A, Koyama H, Tanaka S, Maeno T, Komatsu M, Fukumoto S, Emoto M, Shoji T, Inaba M, Shioi A, Miki T. Arterial wall stiffness is associated with peripheral circulation in patients with type 2 diabetes. *Atherosclerosis*. 2003 Sep 1;170(1):87-91
22. Rabia K, Khoo EM. Prevalence of peripheral arterial disease in patients with diabetes mellitus in a primary care setting. *Medical Journal of Malaysia*. 2007;62(2):130-3.
23. Wukich DK, Raspovic KM, Suder NC. Prevalence of peripheral arterial disease in patients with diabetic Charcot neuroarthropathy. *The Journal of Foot and Ankle Surgery*. 2016 Jul 1;55(4):727-31.
24. Premalatha G, Shanthirani S, Deepa R, Markovitz JE, Mohan VI. Prevalence and risk factors of peripheral vascular disease in a selected South Indian population: the Chennai Urban Population Study. *Diabetes care*. 2000 Sep 1;23(9):1295-300.
25. Thiruvoipati T, Kielhorn CE, Armstrong EJ. Peripheral artery disease in patients with diabetes: Epidemiology, mechanisms, and outcomes. *World journal of diabetes*. 2015 Jul 10;6(7):961.
26. Abishai A. A study to evaluate the effectiveness of Buerger-Allen exercise in improving peripheral circulation among diabetes mellitus patients in selected hospital at Kanyakumari District (Doctoral dissertation, Global College of Nursing, Kanyakumari) 2016
27. Leelavathi M. Effectiveness of Buerger's Allen exercise on improving the lower extremity perfusion among patients with Diabetes Mellitus admitted at Apollo Hospitals, Chennai (Doctoral dissertation, Apollo College of Nursing, Chennai)
28. Radhika J, Poomalai G, Nalini S, Revathi R. 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*. 2020 Jul;25(4):291.
29. Margret WJ, Tamilselvi S, Mekala VC. A Study to Evaluate the Effectiveness of Buerger Allen Exercise on improving lower Extremity perfusion among patients with Type II Diabetes Mellitus in selected Hospitals at Erode. *Asian Journal of Nursing Education and Research*. 2021 Apr 1;11(2):249-52.
30. Hemalatha K. Effectiveness of Buerger Allen exercise on lower extremity perfusion among patients with type 2 diabetes mellitus in selected hospitals at Kanniyakumari District (Doctoral dissertation, Thasiah College of Nursing, Marthandam.
31. Hafid MA, Ilmi AA, Hasnah H. Buerger Allen exercise review on peripheral circulation in diabetes mellitus patients: a literature review. *Jurnal Kesehatan*. 2020;13(1):28-38.
32. 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*. 2018;3(9):15-20.
33. Thakur P, Sharma K. A Study to Assess the Effectiveness of Buerger Allen Exercise in Improving the Peripheral Circulation among Patients with Diabetes Mellitus Admitted in Sharda Hospital, Greater Noida. *Amarjeet Kaur Sandhu*. 2019 Apr;11(2):27.
34. El-Fattah HS, Garas AF, Hanna NE, Elsayed NM. Effect of Buerger Exercises on Improving Peripheral Circulation of the Lower Extremities among Patients with Type 2 Diabetes Mellitus at Selected University Hospital–Egypt. *SCOPUS IJPHRD CITATION SCORE*. 2019 Jun;10(6):719.
35. Kothari CK. *Research Methodology Methods and technology*. Bangalore: Wishwa Prakhasan Publisher; 1996.
36. Dempsey AP, Dempsey DA. *Using nursing research process: critical evaluation and utilisation*, 5th ed, Philadelphia. Lippincott Publisher; 2000.
37. Burns N and Groove SV. *Practice of nursing research conduct; critique and utilization*. Philadelphia: W.B. Saunders Company; 1990
38. Polit DF, Hungler BP *Nursing Research Principles and Methods*, Philadelphia: J.B Lippincott Company, 1999.
39. Treece EW, Treece JW. *Elements of research in nursing*. Philadelphia: C.V. Mosby Company, 1999.
40. Basavanthappa BT. *Nursing research*. New Delhi: Jaypee Brothers Medical Publishers Pvt. Ltd.; 2003.