

The Effect of Buerger Allen Exercise and Walking Exercise on Ankle Brachial Index among Patients with Type-2 Diabetes Mellitus

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Abstract

Original Research Article

Background: The global escalation of Diabetes Mellitus, particularly Type 2, brings a high risk of chronic complications. Prolonged hyperglycemia leads to peripheral arterial narrowing, significantly decreasing blood flow to the lower extremities. This reduced perfusion is a primary cause of peripheral neuropathy and diabetic foot ulcers. Early detection is needed through measuring the Ankle Brachial Index and implementing Buerger Allen Exercise and Walking Exercise, which can increase blood circulation to the extremities as an effort to prevent and reduce the risk of diabetic ulcers. **Aim:** This study aims to determine the effect of Buerger Allen Exercise and Walking Exercise on the Ankle Brachial Index in patients with Diabetes Mellitus. **Methodology:** Using a quasi-experimental design with pre-test and post-test approach, purposive sampling technique was used with a sample size of 30 people in the intervention group and 30 people in the control group. The tool used to measure the Ankle Brachial Index is a digital sphygmomanometer. The statistical tests used are paired sample t-test and independent sample t-test with a significance level of 0.05. **Results:** There was a difference in the average value of the Ankle Brachial Index before and after being given exercise in the intervention group; difference between mean pre-test [0.748] and mean post-test [0.812] scores of interventional group, found to be statistically difference at 0.05 level of significant with a p value of 0.001 [$t=12.16$ (p value=0.001) $p<0.05$] also the results of the statistical test showed that there was a difference in the mean value of the post-test score between the intervention group(0.812) and the control group(0.739) with a p-value of 0.041($p<0.05$). **Conclusion:** Buerger Allen exercise and walking exercise can improve and increase peripheral circulation to the extremities.

Keywords: Ankle Brachial Index, Buerger Allen Exercise, Diabetes Mellitus, Walking Exercise.

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INTRODUCTION

Diabetes mellitus is a chronic condition that occurs when the pancreas fails to produce enough insulin or when the body cannot effectively use it, leading to abnormally high blood glucose levels. Type 2 diabetes mellitus (T2DM), the most prevalent form, is primarily caused by insulin resistance and relative insulin deficiency associated with lifestyle and genetic factors [1]. Diabetes mellitus represents a significant and growing global health burden. According to the International Diabetes Federation (IDF), approximately 537 million adults (aged 20–79 years) were living with diabetes in 2021, and this number is projected to rise

to 643 million by 2030 and 783 million by 2045 if current trends continue [3]. The majority of these cases are Type 2 diabetes mellitus (T2DM), accounting for more than 90% of all diabetes cases [2].

Diabetes mellitus, particularly T2DM, is associated with a wide range of microvascular and macrovascular complications. Microvascular complications include diabetic retinopathy, nephropathy, and neuropathy, while macrovascular complications involve coronary artery disease, peripheral arterial disease, and stroke [3]. These complications significantly impact quality of life and increase the risk of morbidity

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and premature mortality among individuals with type 2 diabetes mellitus. Peripheral arterial disease (PAD), in particular, is a significant concern in diabetic populations, Chronic hyper glycemia contributes to endothelial dysfunction, increased inflammation, and accelerated atherosclerosis, all of which narrow and stiffen the arteries supplies the lower limbs⁴ as it can lead to poor circulation in the lower limbs, foot ulcers, infections, and ultimately limb amputations diabetes impairs blood circulation, particularly in the lower extremities, which delays wound healing and predisposes individuals to infections [5].

The Ankle Brachial Pressure Index (ABPI) is a non-invasive and painless test used to assess peripheral artery disease (PAD) in individuals with diabetes. By measuring the ABPI can help identify PAD and guide further management to prevent complications. The Ankle-Brachial Index (ABI) is the ratio of the systolic pressure at the ankle to that in the arm. Generally, the higher systolic pressure in the dorsalis pedis and in the posterior tibial arteries serves as the numerator and the higher systolic pressure in the brachial serves as the denominator [5]. In diabetic patients, ABPI is a valuable tool for early detection and prevention of PAD [7]. Improving ABPI through simple, non-pharmacological interventions can therefore play an important role in preventing complications among diabetic patients. One such effective and low-cost method is the Buerger–Allen exercise (BAE). This exercise involves a sequence of limb elevation, dependency, and rest positions to promote blood flow to the legs. The Buerger–Allen exercise is a simple leg exercise designed to improve circulation in the lower limbs. It involves a sequence of movements such as raising, lowering, and resting the legs in specific positions to encourage blood flow. These exercises help to activate the muscle pump, promote arterial inflow, and improve venous return. The main advantage of this exercise is that it does not require any equipment and can be performed easily at home or in clinical settings [8]. Therefore, a need to conduct a study to assess and compare the effectiveness of Buerger–Allen exercise and walking exercise on ABPI values among patients with Type 2 diabetes mellitus. Such a study will provide scientific evidence regarding their role in improving peripheral circulation, reducing the risk of ischemic complications, and enhancing overall quality of life. Establishing their effectiveness could encourage routine incorporation of these exercises into diabetic care protocols and community-based health programs. This study will find out the effect of combination of BAE and walking exercise on the ABPI value of type 2 DM patients.

MATERIAL AND METHODS

The research design used was quasi-experimental with non-equivalent control group design approach to determine the effect of Buerger Allen Exercise and Walking Exercise on Ankle Brachial Index

in patients with Diabetes mellitus. A sample of 60 type 2 DM patients were selected from HSK Hospital Bagalkot. Respondents in the study were divided into 2 groups; namely, the intervention group and the control group selected by researchers without randomization. Written consent was taken from participants for the study. The instruments used were a digital sphygmomanometer and a worksheet to measure and record ABI values. The digital sphygmomanometer used has been tested for validity and reliability. The respondent identity questionnaire component contains the respondent initials, gender, age, smoking history, co-morbidities, duration of suffering from DM, blood sugar levels and ABI value. The data was analyzed by using descriptive and inferential statistical in terms of frequency, percentage, mean, and standard deviation, paired “t” test and Chi square test.

Study Design

The research design selected for the present study is “Quasi experimental two group pre-test post-test design”. This type of design does not have strict limits on randomization; it could introduce bias or limit the ability to conclude causal relationships. However, to prevent bias, careful planning and implementation of the study are carried out where researchers seek respondents based on pre-determined inclusion and exclusion criteria.

Setting of the Study

The present study was conducted at HSK Hospital, Bagalkot. The study setting was selected according to the availability of type 2 DM patients at HSK Hospital, Bagalkot.

Participants

In the present study, the participants were type 2 DM patients. The sample consisted of 60 type 2DM patients who met the inclusion criteria, segregated 30 in each experimental and control group respectively.

Instruments

The study was conducted using a self-structured questionnaire that included items related to socio-demographic variables. The Digital sphygmomanometer and an ABI worksheet were used to assess and record ABPI.

Description of Data Collection Instruments PART I: SOCIO-DEMOGRAPHIC DATA:

The first part of the tool consists of 7 items for obtaining information of the selected background factors such as age, gender, duration of suffering from DM, co-morbid condition, smoking history, duration of smoking, and random blood sugar level.

PART II: Digital sphygmomanometer and ABPI worksheet.

Digital sphygmomanometer and ABPI worksheet were used to assess the level of ABPI in experimental group and control group.

Data Collection Procedure

Collection of Data

Data collection was done from 20-11-2025 to 04-11-2025 at HSK Hospital Bagalkot. Permission was obtained from the Dean HSK hospital and research centre, Bagalkot. The objectives of the study were explained to the Administrator and the Nursing Superintendent. The samples were selected by purposive sampling technique. Data was collected from the medical and surgical wards. The purpose of the study was explained and written consent was obtained from all patients before the study. 60 patients in medical and surgical wards who are diagnosed with type 2 DM was assessed ABPI using digital sphygmomanometer to know the effect of BAE and walking exercise to increase ABPI level. Post-test done by the researcher after 2 weeks. The researcher himself collected the data by using digital sphygmomanometer and with the help of ABI worksheet.

Variables under Study:

1. Independent Variable:

Independent variables are the variables that are purposely manipulated or changed by the researcher. In this study, BAE and walking exercise are independent variable.

2. Dependent Variable:

A dependent variable is a response, behaviour or outcome that the researcher wants to predict or explain. In this study, ABPI level is the dependent variable.

3. Demographic Variables:

Demographic variables are characteristics or attributes of subjects. In this study the socio demographic variables are age, gender, duration of suffering from DM, co-morbid condition, smoking history, duration of smoking, and random blood sugar level.

Statistical Analysis:

The data obtained is analyzed in terms of objectives of the study using descriptive and inferential statistics. The plan of data analysis is as follows:

Descriptive Statistics

1. The frequency and percentage distribution was used to analyze the demographic variables and level of ABPI among type 2 DM patients.
2. Mean and Standard deviation was used to assess the effectiveness of BAE and walking exercise to increase the ABPI level.

Inferential Statistics

1. Independent t- test was used to assess the effectiveness between two groups.
2. Chi square test was used to find out the association of post test scores with their selected demographic variables. The level of significance would be set at $p \leq 0.05$ levels to test the significance of difference.

This level is often used as a standard for testing the difference.

Ethical Approval:

The present study was accepted from institutional ethical committee of B V V S Sajjalashree Institute of Nursing Sciences, Bagalkot.

RESULTS

Part I: Socio-Demographic Variables

The number of adults between 30-40 years in experimental group is 3 and whereas control group is 8. The number of adults between 41-50 years in experimental group is 10 and that of control group is 10. The number of adults between 51-60 years in experimental group is 9 and that of control group is 10. Also there are 8 members in experimental group and 2 members are in control group who comes under the age group of 61-70 years. There are 17 Males in experimental group and where as in 17 males in control group. There are 13 females in experimental group and where as in 13 Females in control group. For duration of suffering from DM majority of the sample belongs to 1-5 year duration, the control group has 16 participants while the experimental group follows 14. For the 6-10 years duration, the control group has 12 participants and 11 in the experimental group. In the 11-15 years duration experimental group having 4 participants and the control group having only 2. Finally, in the > 15 years category, the experimental group has a single participant (1) while the control group has none (0). Co morbid condition of the samples shows that 4 members in experimental group and 3 members in control group suffers from heart disease. 14 members of the experimental group and 2 members of control group have hypertension. Regarding obesity 13 members from experimental group and 5 members from control group are affected. Finally, 4 members of the experimental group and 18 members of the control group suffer from other miscellaneous conditions. In history of smoking 12 members from experimental group and 10 members from control group have the habit of smoking. Meanwhile rest of the samples has no habit of smoking. Duration of smoking of the samples who having the history of smoking shows that 5 members in experimental group and 6 members in control group have a smoking duration of 1-5 years. It also shows that 3 members from the experimental group and 3 members from the control group have a duration of 6-10 years. 3 members of experimental group and 1 member of the control group have a smoking duration of 11-15 years. 1 member of the experimental group and 0 members of the control group have a smoking duration of >15 years. Regarding blood sugar level of type2 DM patients 0 members from experimental group and members from control group have a blood sugar level of 120- 140 mg/dl. It also shows that 13 members from experimental group and 15 from control group have a level of 141-199 mg/dl. 12 members of experimental group and 7 members of the control group have a blood

sugar level of 200-300 mg/dl. Finally, 5 members of experimental group and 2 members of control group have a blood sugar level of >300 mg/dl.

PART II Evaluation of the Effectiveness of BAE and Walking Exercise on ABPI among type 2 DM patients

Objective: To determine the effect of BAE and walking exercise on the ABPI in patients with type 2 diabetes mellitus.

Level of ABPI	Mean	SD	Mean Diff.	SD Diff.	t-value	p-value
Pre-test	0.748	0.119	0.064	0.005	12.16	0.001
Post-test	0.812	0.124				

P value is <0.05

Table 5.14 of the difference between pre-test and post-test ABPI scores of the type2 DM patients shows that, difference between mean pre-test [0.748] and mean post-test [0.812] scores, found to be statistically difference at 0.05 level of significant [t=12.16(p value=0.001) p<0.05].

Hence it is clear that there is a statistically difference between mean post-test level of ABPI and mean pre-test level of ABPI among patients with type 2 DM subjected to BAE and walking exercise. Hence H1 is accepted. There will be significant difference between

H1: There will be significant difference between mean pretest and post test score of experimental group ABPI among patients with type 2 DM.

mean pretest and post score toward level of ABPI among patients with type 2 DM subjected to BAE and walking exercise. Findings related to the significance.

PART III: Compare the Post Test Score of Experimental Group and Control Group Among Patients with Type 2 DM Patients

Objective No.3: To find out the association of pre test score with their socio-demographic variable in patients with type 2 diabetes mellitus (both groups)

Table 5.15: Comparison between Post-test experimental group and post-test control group score on in ABPI level among patients with

Group	Mean	SD	M.D	T. CAL	P Table
Experimental Group	0.812	0.124	0.073	2.093	0.041
Control Group	0.739	0.109			

P value is <0.05

The table 5.14 represents to compare the mean and standard deviation of the post-test level of ABPI among patients with type 2 DM patients in experimental group and control group. In experimental group the mean score was 0.812 with standard deviation of 0.124 and in control group the mean score was 0.739 with standard deviation of 0.109. The mean difference was 0.073 and the calculated t value was 2.093 indicating that there was a significant difference in post-test level of ABPI among

patients with type 2 DM in experimental group and control group at P<0.05.

Thus the Implementation of BAE and walking exercise was successful in increasing the level of ABPI among the patients with type 2 DM. Hypothesis 2 is accepted; there will be significant difference between mean post test score of experimental group and control group

Table 5.16: association of pre test score with their socio-demographic variable experimental group.

Sl. No	Socio Demographic variables	Chi Square	P Value	Signification
1	Age	5.4741	0.4846	not significant
2	Gender	5.0505	0.0800	not significant
3	Duration of DM	16.63	0.0107	significant
4.a	Heart disease	3.1111	0.2111	not significant
4.b	Hypertension	0.1705	0.9183	not significant
4.c	Kidney disease	0.595	0.7427	not significant
4.d	Obesity	0.064	0.9685	not significant
4.e	Other	0.854	0.6525	not significant
5	History of smoking	1.875	0.391	not significant
6	Duration of smoking	2.333	0.8867	not significant
7	Blood sugar level	15.541	0.0037	significant

Findings related to the association between pretest scores of Type 2 DM with their selected socio demographic variables reveals that, there was no significant association found between the pre test level of Type2 DM score of patients of Age ($\chi^2=5.4741$, $P=0.4846$), Gender ($\chi^2=5.0505$, $P=0.0800$),Duration of DM ($\chi^2=16.63$, $P= 0.0107$),Heart disease ($\chi^2=3.1111$,

$P= 0.2111$),Hypertension ($\chi^2=0.1705$, $P=0.9183$), Kidney disease ($\chi^2=0.595$, $P=0.7427$),Obesity ($\chi^2=0.064$, $P=0.9685$),Others ($\chi^2=0.854$, $P=0.6525$), History of smoking ($\chi^2=1.875$, $P=0.391$),Duration of smoking ($\chi^2=2.333$, $P=0.8867$), Blood sugar level ($\chi^2=15.541$, $P=0.0037$).

Table 5.17: association of pre test score with their socio-demographic variable control group.

Sl. No	Socio Demographic variables	Chi Square	P Value	Signification
1	Age	4.8700	0.5606	not significant
2	Gender	5.0505	0.0800	not significant
3	Duration of DM	2.31	0.67	not significant
4.a	Heart disease	0.4072	0.8158	not significant
4.b	Hypertension	7.556	0.0229	significant
4.c	Kidney disease	0.461	0.7941	not significant
4.d	Obesity	0.511	0.7745	not significant
4.e	Others	1.111	0.5737	not significant
5	History of smoking	0.680	0.711	not significant
6	Duration of smoking	0.625	0.7316	not significant
7	Blood sugar level	4.622	0.5932	not significant

Findings related to the association between pretest scores of Type2 DM patients with their selected socio demographic variables reveals that, there was no significant association found between the pretest level of Type2 DM score of patients of Age ($\chi^2=4.8700$, $P=0.5606$), Gender ($\chi^2=5.0505$, $P=0.0800$), Duration of DM ($\chi^2=02.31$, $P=0.67$), Heart disease($\chi^2=0.4072$, $P=0.8158$), Hypertension ($\chi^2=7.556$, $P=0.0229$), Kidney disease ($\chi^2=0.461$, $P=0.7941$), Obesity ($\chi^2=0.511$, $P=0.7745$), Others ($\chi^2=1.111$, $P=0.5737$), History of smoking ($\chi^2=0.680$, $P=0.711$), Duration of smoking ($\chi^2=0.625$, $P=0.7316$), Blood sugar level ($\chi^2=4.622$, $P=0.5932$).

Hence H3: There is no association of pretest score with their socio-demographic variable in patients with Type 2 DM is rejected.

Summary:

The chapter dealt with the analysis and interpretation of the findings of the study. The data gathered were summarized in the master sheet and both descriptive and interstitial statistics were used for the analysis. Findings reveals that pre-test level of ABPI score and post-test level of ABPI score has significant difference. Paired 't' test was used to analyze the effect of BAE and walking exercise on level of ABPI which showed that performing BAE and walking exercise is significant for increasing ABPI level.

DISCUSSION

The findings of the present study are discussed in light of previous scientific studies in this chapter and discussion regarding findings of the study is presented in accordance with the objectives of the study and hypothesis. The present study was designed to find out

the “The Effect of Buerger Allen Exercise and Walking Exercise on Ankle Brachial Index among Patients with Type-2 Diabetes Mellitus”. The study found that there is effectiveness on Buerger Allen Exercise and Walking Exercise on Ankle Brachial Index among Patients with Type-2 Diabetes Mellitus.

Findings related to the significance of the difference between pre-test and post test scores of the type 2 DM patients shows that the difference between pre-test and post-test ABPI scores of the type2 DM patients shows that, difference between mean pre-test [0.748] and mean post-test [0.812] scores, found to be statistically difference at 0.05 level of significant [$t=12.16$ (p value= 0.001) $p<0.05$]Hence it is clear that there is a statistically difference between mean post-test level of ABPI and mean pre-test level of ABPI among patients with type 2 DM subjected to BAE and walking exercise. Hence Hypothesis 1 is accepted.

The above study findings were supported by a quasi- experimental study conducted to asses Effectiveness of Buerger Allen Exercise to Prevent Risk of Diabetic Foot by Improving Lower Extremity Perfusion among Clients with Type-2 Diabetes Mellitus in Selected Hospitals at Villupuram District, Tamil Nadu 60 samples (experimental 30, control 30) selected by using non-probability purposive sampling technique. The data were collected using demographic variables, clinical variables and ABI score devised by the investigator for 30 minutes for each participant in both the experimental and control group. After the pretest, only the experimental group was administered Buerger Allen Exercise twice a day for 5 days with the interval of six hours. The control group was allowed to follow the regular activities in the hospital. After 5 days, the post test was conducted by using ABI score devised by the

investigator for both the groups. The findings of the study showed that in experimental group the post-test mean score was 0.921 with S.D of 0.083 and in the control group, post-test mean value is 0.734 with SD is 0.063. The calculated paired „t“ test value 4.97. The Study concluded that that the Buerger Allen exercises is an effective intervention in improving lower leg perfusion among clients with Type II DM [9].

To compare the mean and standard deviation of the post-test level of ABPI among patients with type 2 DM patients in experimental group and control group. In experimental group the mean score was 0.812 with standard deviation of 0.124 and in control group the mean score was 0.739 with standard deviation of 0.109. The mean difference was 0.073 and the calculated t value was 2.093 indicating that there was a significant difference in post-test level of ABPI among patients with type 2 DM in experimental group and control group at $P < 0.05$.

Thus the Implementation of BAE and walking exercise was successful in increasing the level of ABPI among the patients with type 2 DM. Hypothesis 2 is accepted; there will be significant difference between mean post test score of experimental group and control group.

The above findings were supported by a quasi-experimental study was conducted to determine the effectiveness of Buerger-Allen Exercise on Lower Extremity Perfusion and Peripheral Neuropathy Symptoms among Patients with Diabetes Mellitus prospectively conducted from July 2017 to October 2017 at the medical and surgical wards of Sri Ramachandra Hospital, Porur, Chennai. Fifty DM patients between the ages of 30 and 75 from both genders were selected using a purposive sampling technique and were assessed for LEP with a manual Ankle-Brachial Index (ABI) scale and assessed for PNS with Michigan Neuropathy Screening Instrument (MNSI). The BAE was demonstrated for 4 consecutive days. The intervention was repeated five times per day for each patient and the post test was conducted 5th day using the same tools. The majority ($n = 75$, 75%) were 60–69 age group and 98% had education till primary school. 62% had diabetes and 20% of them had a history of peripheral arterial disease. 50% of participants had mildly impaired perfusion during pretest whereas abnormal neuropathy was seen in more than 70% cases which decreased post-test. A significant difference in PNS was seen after the implementation of BAE in both right LEP [10].

Findings related to the association between pretest scores of Type 2 DM with their selected socio demographic variables reveals that, there was no significant association found between the pre test level of Type2 DM score of patients of both groups. Hence H3 is rejected.

Limitations: The study limited to the sample of 60 patients with type 2 DM admitted at, B.V.V.S HSK Hospital, Bagalkot

CONCLUSION

Effect of BAE and walking exercise on ankle brachial pressure index among patients with type 2 DM of was shown by comparison of pre test mean score(0.748) and post test mean score(0.812) of the experimental group and comparison of means scores of ABPI in experimental and control group the post-test mean score is 0.812 and 0.739 respectively shows that there is a significant effect on ABPI after administration of interventions among patient with type 2 DM in experimental group when compared to control group and it is found to be statistically significant.

DECLARATION BY AUTHORS

Ethical Approval: Institutional ethical clearance approved.

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