Effect of Buerger Allen Exercise on Health Outcomes of Patients with Varicose Veins

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Abstract

Background: Varicose veins disease is a chronic venous disease that progressively diminishes patients' quality of life and imposes an escalating strain on healthcare resources. **Aim of the study:** To evaluate the effect of Buerger Allen exercise on health outcomes of patients with lower limbs' varicose veins. **Research design:** Quasi-experimental (pre and post intervention) comparison study design. **Setting:** General surgery outpatients' clinic at Benha University Hospital, Benha, Qalyubia Governorate, Egypt. **Sample:** Purposive sample of 69 adult patients with grade 3 lower limbs' varicose veins. **Tools:** Five tools were used; (1) Structured interviewing questionnaire, (2) National Health Service varicose vein grading system, (3) Pain visual analog scale, (4) Pitting edema grading system and (5) Patients' practice observational checklist. **Results:** There was a highly significant statistical difference (p ≤ 0.001) regarding studied patients' total knowledge & practice throughout different study phases of implementing educational intervention. Also, there was a highly significant statistical difference (p ≤ 0.001) regarding studied patients' lower limbs' pain intensity & grade of edema throughout different study phases of implementing Buerger Allen exercise, while there was no deterioration in studied patients' grade of varicose veins. **Conclusion:** The educational intervention was effective in improving patients' level of total knowledge & practice regarding lower limb's varicose veins & Buerger Allen exercise. Also, Buerger Allen exercise was effective in decreasing patients' lower limbs' pain intensity & grade of edema, as well as preventing deterioration of patients' grade of varicose veins and preventing complications. **Recommendations:** Ongoing educational interventions are needed to improve patients' health outcomes, knowledge & practice regarding lower limb's varicose veins & Buerger Allen exercise.

Keywords: Buerger Allen Exercise, Health Outcomes & Varicose Veins.

Introduction

Varicose Veins Disease (CVD) is a chronic venous disease that progressively diminishes patients' quality of life and imposes an escalating strain on healthcare resources **(Mulita et al., 2024)**. Varicose veins are characterized by dilated, elongated, and/or tortuous veins caused by permanent loss of its valvular efficiency. Destruction of venous valves in the axial veins results in venous reflux, hypertension, and total dilatation, causing varicosities and transudation of fluid into subcutaneous tissue **(Ghosh et al., 2021)**.

Treatment options for varicose veins include conservative treatment that includes compression therapy, medicines, and lifestyle modifications, and invasive treatment that includes endovenous thermal ablation, injection sclerotherapy, and surgery. The selection of treatment is largely based on the patient's cause, location, signs, symptoms & potential complications of varicose veins, the patient's preference, the cost, and the

available medical resources **(El-Sayed & Abu Zead, 2023)**.

Exercises has been considered as one of the most effective non-pharmacological managements that help to stimulate peripheral circulation. Buerger-Allen exercise (BAE) is an active postural exercise in which gravity alternatively fills and empties the blood vessels which helps to promote blood circulation of the lower limbs and drain engorged vessels through postural changes **(Zaki et al., 2023)**. Leo Buerger performed the original BAE in 1924, and Arthur Allen improved it in 1930 to include gravitational forces delivered to the smooth muscles and the vascular system in various positions **(Afida et al., 2022)**.

Nurses have an effective role in the management of diseases and prevention of complications through educational interventions and providing health care. Nurses can facilitate active participation of patients and their families in care, and they can also teach patients about the principles of care, the prevention of complications, and the importance of regular follow up visits **(Zaki et al., 2023)**.

Significance of the study

Varicose veins disease is a prevalent vascular condition. The worldwide prevalence ranges from 20 to 60% and women are at two to three times more risk of developing varicose veins than men **(Naik & Monteiro, 2024)**. The prevalence of chronic venous diseases and varicose veins vary mostly by region. In Egypt, **Aly et al. (2020)** conducted a cross-sectional study on women and found that 51.1% of women aged 15-55 years old had varicose veins **(El-Sayed & Abu Zead, 2023)**. According to Benha University Hospital annual census (2022), the number of leg varicose veins patients in general surgery outpatient clinic was 480 patients **(Benha University Hospital statistics office, 2022)**.

Buerger Allen exercise includes gravitational changes in the position which help to improve lower limbs' circulation, increase blood flow rate, empty engorged blood vessels, and relieve associated signs & symptoms. Also, Buerger Allen exercise is noninvasive, low risk, low cost, and easy to learn physical activity **(Saleh et al., 2024)**. So, it can be effective in the management of patients with lower limbs' varicose veins.

Therefore, assessing patients' knowledge & practice regarding lower limbs' varicose veins & Buerger Allen exercise, grade of lower limbs' varicose veins & associated symptoms, as well as providing needed educational intervention are important. So, the current study was conducted to evaluate the effect of Buerger Allen exercise on health outcomes of patients with lower limbs' varicose veins.

Aim of the study

The aim of the current study was to evaluate the effect of Buerger Allen exercise on health outcomes of patients with lower limbs' varicose veins.

Research hypotheses

H1: Mean knowledge scores of the studied patients post implementing educational intervention could be significantly increased than before.

H2: Grade of lower limbs' varicose veins of the studied patients post implementing Buerger Allen exercise could be significantly decreased than before.

H3: Lower limbs' pain and edema of the studied patients post implementing Buerger Allen exercise could be significantly decreased than before.

H4: Mean practice scores of the studied patients post implementing educational intervention could be significantly increased than before.

Effect of Buerger Allen Exercise on Health Outcomes of Patients with Varicose Veins

Subjects and Methods
Research design

Quasi-experimental (pre and post intervention) comparison study design was utilized to achieve the aim of the current study. Quasi-experimental research design aims to establish a cause-and-effect relationship between an independent and dependent variable, and it is a useful tool in situations where true experiments cannot be used for ethical or practical reasons **(Thomas, 2024)**.

Setting

The study was conducted in general surgery outpatients' clinic at Benha University Hospital, Benha, Qalyubia Governorate, Egypt. This clinic is located in the basement floor, in the opposite of urinary tract outpatient clinic. It includes 2 rooms, 2 beds, and 2 desks: One for doctors & the other for nurses.

Sample

Sample type: Purposive sample of 69 adult patients (after exclusion of patients who were involved in the pilot study), with age ranging from 21-60 years old, from both sexes with lower limbs' varicose veins who were able to communicate and agreed to participate in the study.

Sampling technique: After defining the target population and determining inclusion & exclusion criteria, the researchers selected the subjects who fit the study to be included in the sample.

Calculation of sample size: The sample size was calculated based on the number of patients with lower limbs' varicose veins in general surgery outpatients' clinic, according to Benha University Hospital annual census (2022), which was 480 patients (120 patients with third degree lower limbs' varicose veins) using the following equation **(Thompson, 2012)**:

$$n = \frac{N \times p\,(1-p)}{\left(\left(N-1 \times (d^2 \div z^2)\right) + p\,(1-p)\right)}$$

Where:

n = Sample size.
N = Community size (120 patients).
p = Ratio provides a neutral property = 0.125.
d = The error rate = 0.05.
z = Class standard corresponding to the level of significance = 0.95 and 1.96.
So, 69 patients were included in the study.

Inclusion criteria: Patients with grade 3 lower limbs' varicose veins who were able to implement the interventional exercise.

Exclusion criteria: Patients with other peripheral vascular disease or deep vein thrombosis, hearing impairment, vertebral deformities/injuries, dementia, Alzheimer's disease or psychiatric disorders, and unconscious patients.

Tools of data collection

Five tools were used to collect data for the current study as follows:

Tool (I): Structured interviewing questionnaire:

This tool was designed by researchers based on relevant literature **(Buerger, 1924, Allen, 1930, Raetz et al., 2019, Aly et al., 2020, Ghosh et al., 2021, Mohammad et al., 2021, Miskin, 2022 and Shernazarov et al., 2022)**. It included 32 questions and divided into **three parts** as follows:

Part (1): Patients' personal data:

This part was concerned with assessment of studied patients' personal data and contained 10 questions.

Part (2): Patients' medical data:

This part was concerned with assessment of studied patients' medical data and contained 6 questions.

Part (3): Patients' knowledge regarding lower limbs' varicose veins and Buerger Allen Exercise:

This part was concerned with assessment of studied patients' knowledge regarding lower limbs' varicose veins and Buerger

Allen exercise and contained 16 multiple-choice questions.

Tool (II): National Health Service varicose vein grading system:

This tool was adopted from (**Black, 2022**), concerned with assessment of studied patients' grade of lower limbs' varicose veins, and contained 6 grades.

Tool (III): Pain visual analog scale:

This tool was adopted from (**Saad & Elnemr, 2021**), concerned with assessment of studied patients' lower limbs' pain intensity, and the scale was graduated from 0 to 10.

Tool (IV): Pitting edema grading system:

This tool was adopted from (**Smith et al., 2021**), concerned with assessment of studied patients' grade of lower limbs' edema, and contained 5 grades.

Tool (V): Patients' practice observational checklist:

This tool was adopted from (**Buerger, 1924 and Allen, 1930**), concerned with assessment of studied patients' practice of Buerger Allen exercise, and included 3 steps.

*Educational booklet regarding lower limbs' varicose veins and Buerger Allen exercise

The educational booklet was designed by researchers through reviewing of recent related literatures and scientific references (**Buerger, 1924, Allen, 1930, Raetz et al., 2019, Aly et al., 2020, Ghosh et al., 2021, Mohammad et al., 2021, Miskin, 2022 and Shernazarov et al., 2022**), and covered knowledge regarding lower limbs' varicose veins and Buerger Allen exercise.

Validity of tools

The tools were reviewed by a panel of five experts from the medical surgical nursing field, Faculty of Nursing, Benha University. Jury involved two professors and three assistant professors to test the relevance, comprehension, clarity, and applicability of tools' content. Also, prepared educational booklet which covered items related to lower

limbs' varicose veins and Buerger Allen exercise based on newest current literature was revised by the same experts. Necessary modifications of tools and educational booklet were done accordingly.

Reliability of tools

Tools' reliability was tested statistically to assure that the tools were reliable before data collection. Reliability of **tool I** was determined using Cronbach's alpha coefficient which was 0.686. Reliability of **tool II** was 0.63 (**Hofmann et al., 2023**). Reliability of **tool III** was 0.97 (**Alghadir et al., 2018**). Average reliability of **tool IV** was 0.971 (**Calzon et al., 2023**). Reliability of **tool V** was 0.608. This only proves that these tools have good reliability.

Ethical and administrative considerations:

• Permission to carry out the study was obtained from Scientific Research Ethics Committee in Faculty of Nursing, Benha University with code number (**REC-MSN-P 85**), and from Medical director of Benha University Hospital after explanation of the aim & nature of the study.

• The researchers explained the aim & nature of the study to the study subjects and assured maintaining anonymity & confidentiality of data and that all gathered information will be used only for their benefit and for the purpose of the study.

• The study subjects were informed that their participation is optional, and that they have the right to withdraw at any time without any consequences.

• Verbal and written consent was obtained from each participant enrolled into the study.

Pilot study

Pilot study was performed on 10% (7 patients) of the total sample size to test the clarity and applicability of educational booklet & tools and the time needed for filling in of tools. Needed modifications of educational booklet & tools were done. So, the patients who were involved in the pilot

study excluded from the study sample and replaced by others. Pilot study was done one month prior to data collection.

Field work:

Data collection process included four phases as follows:

1-Assessment phase:

Before implementation of educational intervention & practice of Buerger Allen exercise, the researchers assessed the studied patients' personal data, medical data, and knowledge regarding lower limbs' varicose veins & Buerger Allen exercise using **(Tool I)**, grade of lower limbs' varicose veins using **(Tool II)**, lower limbs' pain intensity using **(Tool III)**, grade of lower limbs' edema using **(Tool IV)** and practice of Buerger Allen exercise using observational checklist **(Tool V)**. Interview took about 45 minutes.

2-Planning phase:

This phase included the following:

1- Determining studied patients' health status and educational needs based on results of assessment phase and preparing for educational and training sessions to meet these needs.

2- Putting plan for carrying out the study, based on studied patients' needs and collected data about the study setting.

3-Implementation phase:

-The researchers divided the studied patients into seven groups. Each group contained about 9-10 patients in every session.

-The researchers attended general surgery outpatients' clinic at Benha University Hospital one day per week (Monday) from 9 AM until 2 PM.

-The researchers conducted two educational & training sessions for each group of the studied patients; one session for theoretical part and another session for practical part.

-Each session lasted about 45 minutes, including periods of discussion according to the studied patients' progress.

4-Evaluation phase:

The evaluation of studied patients' knowledge and practice levels was done immediately after and one month after implementation of educational intervention using data collection tools **(Tool I; part 3 & Tool V)**, and the evaluation of studied patients' health outcomes was done one week after and one month after practice of Buerger Allen exercise using data collection tools **(Tool II, Tool III & Tool IV)**.

Statistical analysis:

Data analysis was performed using the SPSS software (version 25). Kolmogorov-Smirnov test was used to determine the normal distribution of quantitative variables. Chi-square tests were used to compare nominal variables and to examine the relation between qualitative variables. Fisher's exact test was applied on smaller sample sizes, alternative to the chi-square test, when the frequency count is < 5 for more than 20% of cells. The paired t-tests were used to compare the mean scores between two different periods within the same group. Independent t test was used for parametric quantitative data of two groups and anova test for more than two groups. Pearson product-moment correlation coefficient was used to test correlation between different numerical variables. Linear regression was used for multivariate analyses on leg pain intensity as dependent factor. A p-value ≤ 0.05 was considered significant, and ≤ 0.001 was considered highly significant.

Results

Table (1) shows that, 47.8 % of studied patients their age was 50 -60 years with a mean age of 49.14 ± 0.99 years. Related to gender, 87.0 % of studied patients were females, and 76.9 % of them were married. Also, 53.6 % of studied patients obtained secondary education, and 73.9 % of them were residing in rural areas. In addition, 85.5

% of studied patients were working; 47.5 % of them their work required standing for long periods.

Table (2) shows that, mean weight of studied patients was 86.67 ± 13.96 kg, and mean height of them was 163.76 ± 8.15 cm. Also, 59.4 % of studied patients were obese.

Table (3) shows that, 53.6 % of studied patients were suffering from health problem other than lower limbs' varicose veins; 37.8 % of them were suffering from diabetes mellites. Also, 81.2 % of studied patients were suffering from lower limbs' varicose veins for less than 1 year. In addition, 59.4 % of studied patients had family member suffering from peripheral vascular disease; 100.0 % of them were suffering from lower limbs' varicose veins, and 63.4 % of them were second degree of kinship.

Figure (1) illustrates that, satisfactory level of studied patients' total knowledge was among 36.2 % of studied patients before implementation of educational intervention, while improved to be among 89.9 % and 84.1 % of them immediately after and one month after implementation of educational intervention respectively.

Table (4) shows that, there was a highly significant statistical difference ($p \leq 0.001$) regarding studied patients' lower limbs' pain intensity between pre and one week after implementation of Buerger Allen exercise, where the mean score of pain intensity was 3.89 ± 0.71 before implementation, with the highest percent of pain intensity was very severe pain, that improved to be 2.28 ± 0.45 one week after implementation. Also, there was a highly significant statistical difference

($p \leq 0.001$) between pre and one month after implementation of Buerger Allen exercise, where the mean score of pain intensity was 2.22 ± 0.41, with the highest percent of pain intensity was mild pain.

Table (5) shows that, there was a highly significant statistical difference ($p \leq 0.001$) regarding studied patients' grade of lower limbs' edema between pre and one week after implementation of Buerger Allen exercise, where the highest percent of edema grade was grade +2 among 49.3 % of studied patients before implementation, that improved to be grade +1 among 56.5 % of them one week after implementation. Also, there was a highly significant statistical difference ($p \leq 0.001$) between pre and one month after implementation of Buerger Allen exercise, where the highest percent of edema grade was grade 0 among 71.0 % of studied patients.

Figure (2) illustrates that, satisfactory level of studied patients' total practice of Buerger Allen exercise was among 13.0 % of studied patients before implementation of educational intervention, while improved to be among 69.6 % and 62.3 % of them immediately after and one month after implementation of educational intervention respectively.

Table (6) shows that, there was a highly significant statistical positive correlation between studied patients' total knowledge and total practice immediately after and one month after educational intervention implementation with P-values= (<0.001**, <0.001** respectively) and r (≤ 0.799)**,** where the higher the level of knowledge, the higher the level of practice.

Effect of Buerger Allen Exercise on Health Outcomes of Patients with Varicose Veins

Table 1: Distribution of studied patients according to their personal data (n=69)

Patients' personal data	Variables	No.	%
Age (year)	21-<30	6	8.7
	30-<40	11	15.9
	40-<50	19	27.6
	50 -60	33	47.8
	Mean ± SD	**49.14±0.99**	
Gender	Male	9	13.0
	Female	60	87.0
Marital status	Single	2	2.9
	Married	53	76.9
	Divorced	7	10.1
	Widowed	7	10.1
Educational level	Can't read and write	11	15.9
	Read and write	5	7.3
	Secondary education	37	53.6
	University education	16	23.2
Residence	Urban	18	26.1
	Rural	51	73.9
Job	Working	59	85.5
	Not working	10	14.5
The nature of work (n=59)	Work requiring standing for long periods	28	47.5
	Work requiring sitting for long periods	9	15.3
	Work requiring continuous movement	22	37.2

Table 2: Distribution of studied patients according to anthropometric measurements (n=69)

| Anthropometric measurements	Mean ± SD	
Weight (kg)	86.67 ± 13.96	
Height (cm)	163.76 ± 8.15	
BMI (kg/m^2)	No.	(%)
Normal weight (18.5 - 24.9)	10	14.5
Overweight (25–29.9)	18	26.1
Obesity (≥30)	41	59.4

BMI: Body mass index   t: independent t test

Table 3: Distribution of studied patients according to medical data (n=69)

Medical data	Variables	No.	%
Suffer from any health problem other than lower limbs' varicose veins	Yes	37	53.6
	No	32	46.4
The health problem #	**(n= 37)**		
	Heart disease	5	13.5
	Hypertension	7	18.9
	Diabetes mellites	14	37.8
	Kidney disease	7	18.9
	Liver disease	4	10.8
	Bronchial asthma	2	5.4
	Osteoporosis	2	5.4
	Rheumatoid arthritis	1	2.7
Period of suffering from lower limbs' varicose veins	< 1 year	56	81.2
	1-<3 years	4	5.8
	3- <6 years	9	13.0
Presence of any family member suffering from peripheral vascular disease	Yes	41	59.4
	No	28	40.6
The peripheral vascular disease	**(n=41)**		
	lower limbs' varicose veins	41	100.0
The degree of kinship	**(n=41)**		
	First degree	14	34.1
	Second degree	26	63.4
	Third degree	1	2.4

 # Not mutually conclusive
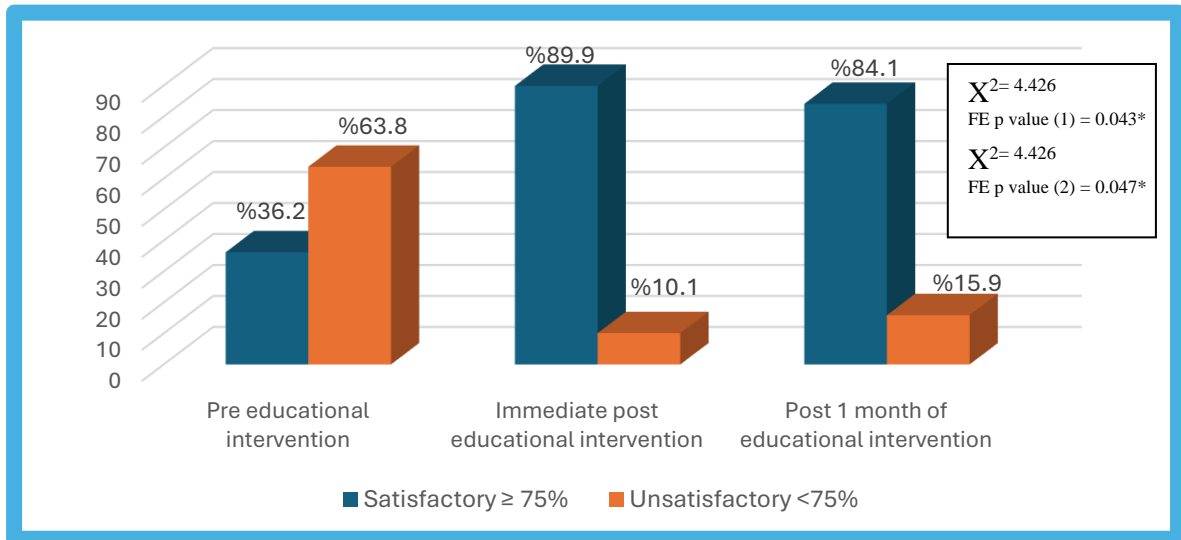
(FE) p value for Fisher exact for chi square   (*) Statistically Significant (p ≤0.05)
  (1) Differences between pre educational intervention and immediately after educational intervention.
  (2) Differences between pre educational intervention and one month after educational intervention.

Figure 1: Differences of studied patients' total knowledge regarding lower limbs' varicose veins and Buerger Allen exercise throughout study phases (n=69):

Effect of Buerger Allen Exercise on Health Outcomes of Patients with Varicose Veins

Table 4: Differences of studied patients' lower limbs' pain intensity throughout study phases (n=69)

Lower limbs' pain intensity	Study phases						X^2 test P value (1)	X^2 test P value (2)
	Pre Burger Allen exercise		One week after Burger Allen exercise		One month after Burger Allen exercise			
	No.	%	No.	%	No.	%		
No pain (0)	0	0.0	0	0.0	0	0.0	12.988 0.002*	25.616 <0.001**
Mild pain (1-3)	0	0.0	7	10.1	49	71.0		
Moderate to severe pain (4-6)	21	30.4	42	60.9	20	29.0		
Very severe pain (7-9)	34	49.3	20	29.0	0	0.0		
Worst pain possible (10)	14	20.3	0	0.0	0	0.0		
Mean ± SD	3.89±0.71		2.28±0.45		2.22±0.41		t= 9.160 <0.001**	t=21.389 <0.001**

(t) paired t test   (*) Statistically Significant (p ≤0.05)   (**) Highly significant (p ≤ 0.001)
(1) Difference between lower limbs' pain intensity pre BAE and one week after BAE.
(2) Difference between lower limbs' pain intensity pre BAE and one month after BAE
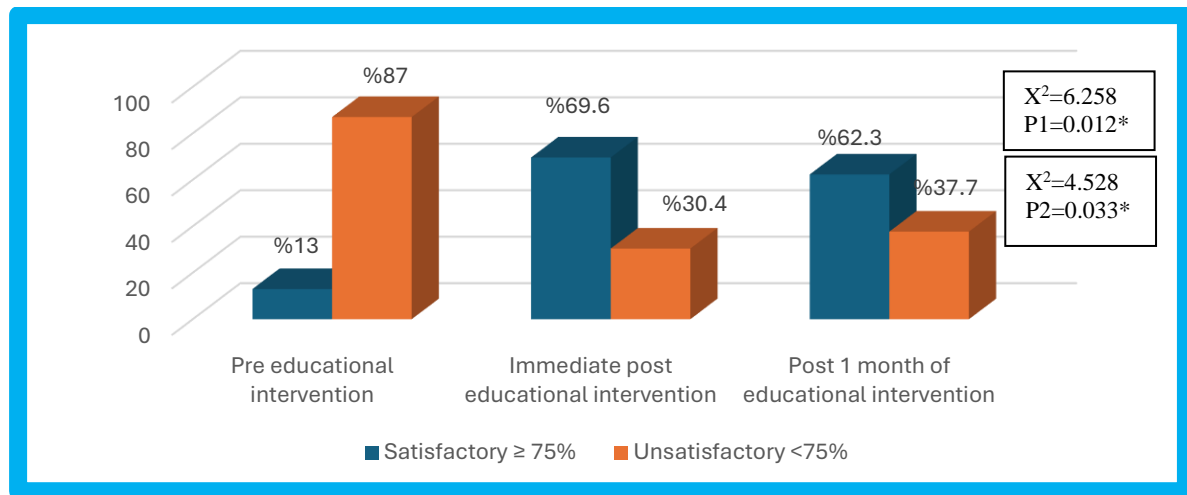
Table 5: Differences of studied patients' grade of lower limbs' edema throughout study phases (n=69)

Grade of lower limbs' edema		Study phases						X^2 test P value (1)	X^2 test P value (2)
		Pre Burger Allen exercise		One week after Burger Allen exercise		One month after Burger Allen exercise			
		No.	%	No.	%	No.	%		
Grade 0	-No clinical edema	0	0.0	16	23.3	49	71.0	24.591 <0.001**	103.966 <0.001**
Grade +1	-Up to 2mm of depression, rebounding immediately.	15	21.7	39	56.5	20	29.0		
Grade +2	-3–4mm of depression, rebounding in 15 seconds or less.	34	49.3	14	20.3	0	0.0		
Grade +3	-5–6mm of depression, rebounding in greater than 15 seconds but less than 60 seconds.	20	29.0	0	0.0	0	0.0		

(**) Highly significant (p ≤ 0.001)
(1) Differences between grade of lower limbs' edema pre BAE and one week after BAE.
(2) Differences between grade of lower limbs' edema pre BAE and one month after BAE

(*) Statistically Significant (p ≤0.05)
  (1) Difference between practice pre BAE and immediately after BAE.
  (2) Difference between practice pre BAE and one month after BAE.

Figure 2: Differences of studied patients' practice of Buerger Allen exercise throughout study phases (n=69)

Table 6: Correlation coefficient between studied patients' total knowledge and practice pre and post educational intervention implementation (n=69):

Variables	Study phases	Total knowledge	
		r	P value
Total practice	Pre educational intervention implementation	0 .183	0.132
	Immediately after educational intervention implementation	0.694	<0.001**
	One month after educational intervention implementation	0.799	<0.001**

(ns) Not significant (p > 0.05)   (**) Highly significant (p ≤ 0.001).

Discussion

Regarding studied patients' personal data, the results of the current study reported that about half of studied patients their **age** was 50 -60 years with a mean age of 49.14 ± 0.99 years.

These findings are in the same line with **Gong et al. (2020)** whose study was about "Reasons for patient non-compliance with compression stockings as a treatment for varicose veins in the lower limbs: A qualitative study" which conducted in China and revealed that the mean age of the study participants was 56.2 years.

These findings are not in the same line with **Shakya et al. (2020)** whose study was about "Varicose veins and its risk factors among nurses at Dhulikhel hospital: A cross sectional study" which conducted in Nepal and revealed that the mean age of participants with varicose veins was 26.8 ± 6.8 years.

As for gender, the results of the current study revealed that the majority of studied patients were females. This finding agrees with **Ali et al. (2021)** whose study was about "Comparative study between conventional stripping surgery and endovenous laser ablation in management of primary lower

limb varicose veins" which conducted in Egypt and revealed that more than half of studied patients were females.

This finding disagrees with **Samane et al. (2020)** whose study was about "Clinical profile of patients with varicose vein: A cross sectional study from Vilasrao Deshmukh government institute of medical sciences, Latur, Maharashtra" which conducted in India and revealed that the majority of studied patients were males.

Concerning marital status, the results of the current study reported that more than three quarter of studied patients were married. This finding agrees with **Elamrawy et al. (2021)** whose study was about "Epidemiological, lifestyle, and occupational factors associated with lower limb varicose veins: A case control study" which conducted in Egypt and revealed that about three quarter of studied patients were married. This finding disagrees with **Shakya et al. (2020)** who reported that more than half of participants with varicose veins were unmarried.

Regarding educational level, the results of the current study reported that more than half of studied patients obtained secondary education. This finding is not in the same line with **Elamrawy et al. (2021)** who reported that the educational level of about three quarter of studied patients was unschooling/basic education.

As regards to residence, the results of the current study revealed that about three quarter of studied patients were residing in rural areas. This finding is in the same line with **Abou-ElWafa et al. (2020)** whose study was about "Lower limb varicose veins among nurses: A single center cross-sectional study in Mansoura, Egypt" and reported that about three quarter of participants with lower limbs' varicose veins were residing in rural areas. While this finding is not in the same line with **Elamrawy et al. (2021)** who reported that the

majority of studied patients were residing in urban areas.

Concerning job, the results of the current study reported that the majority of studied patients were working; about half of them their work required standing for long periods. These findings agree with **Samane et al. (2020)** who reported that almost two third of studied patients belong to the group whose occupation involved prolonged standing.

Regarding Body Mass Index (BMI), the results of the current study reported that more than half of studied patients were obese. This finding agrees with **Elamrawy et al. (2021)** who reported that most of studied patients were overweight and obese.

This finding disagrees with **Mulita et al. (2024)** whose study was about "Demographic and clinical characteristics of patients with varicose veins in Albania: A retrospective, single-centre analysis" and reported that more than half of studied patients had normal body weight.

Regarding patients' medical data, the results of the current study reported that more than half of studied patients were **suffering from health problem other than lower limbs' varicose veins**; about two fifths of them were suffering from diabetes mellites.

These findings are in the same line with **Nishibe et al. (2020)** whose study was about "Bioelectrical impedance analysis of leg edema and its association with venous functions in patients with saphenous varicose veins" which conducted in Japan and revealed that more than half of studied patients were suffering from health problem other than varicose veins.

These findings are not in the same line with **El-Sayed & Abu Zead (2023)** whose study was about "Effect of hot/cold water therapy on lower limb varicose vein: Patients' reported outcomes" which conducted in Egypt and revealed that about two third of the study participants were not suffering from health

problem other than varicose veins.

As for period of suffering from lower limbs' varicose veins, the results of the current study revealed that more than three quarter of studied patients were suffering from lower limbs' varicose veins for less than 1 year. This finding is not in the same line with **Gong et al. (2020)** who reported that the length of time the study participants had been affected by lower limbs varicose veins ranged from 3 to 36 years.

Concerning presence of family member suffering from peripheral vascular disease, the results of the current study reported that more than half of studied patients had family member suffering from peripheral vascular disease; all of them were suffering from lower limbs' varicose veins, and about two third of them were second degree of kinship.

These findings agree with **Ali et al. (2022)** whose study was about "Prevalence of varicose veins among nurses in different departments in Jazan public hospitals, Saudi Arabia: A cross-sectional study" and reported that about two third of participants with varicose veins had family history of varicose veins. These findings disagree with **Shakya et al. (2020)** who reported that about three quarter of participants with varicose veins did not have family history of lower limbs' varicose veins.

The results of the current study reported that satisfactory level of **studied patients' total knowledge** was among more than one third of studied patients before implementation of educational intervention, while improved to be among the majority of them immediately after and one month after implementation of educational intervention, which reflects increase in studied patients' knowledge level.

From the researchers' point of view, unsatisfactory level of knowledge before educational intervention could be related to insufficient public educational campaigns

about lower limbs' varicose veins and Buerger Allen exercise, while satisfactory level of knowledge after educational intervention reflects the effectiveness of the educational intervention that positively increased knowledge level.

These findings support the first research hypothesis (H1) which stated that mean knowledge scores of the studied patients post implementing educational intervention could be significantly increased than before.

These findings are in the same line with **Anwar et al. (2022)** whose study was about "Efficacy of implementing nursing educational program on reduction of risk of varicose veins among nurses at Tanta university hospital" which conducted in Egypt and revealed that implementing educational program improved the knowledge of the study participants regarding varicose veins.

Also, these findings agree with **Rawat & Gholap (2022)** whose study was about "A study to assess the effectiveness of planned teaching program on knowledge and practice regarding Buerger Allen exercise among traffic police with diabetes mellitus of selected urban areas" which conducted in India and revealed that there was a significant increase in mean score of patients' knowledge regarding Buerger Allen exercise after planned teaching program.

The results of the current study reported that there was a highly significant statistical difference ($p \leq 0.001$) regarding **studied patients' lower limbs' pain intensity** between pre and one week after implementation of Buerger Allen exercise, where the mean score of pain intensity was 3.89 ± 0.71 before Buerger Allen exercise implementation, with the highest percent of pain intensity was very severe pain, that improved to be 2.28 ± 0.45 one week after Buerger Allen exercise implementation.

Also, there was a highly significant statistical difference ($p \leq 0.001$) between pre

and one month after Buerger Allen exercise implementation, where the mean score of pain intensity was 2.22±0.41, with the highest percent of pain intensity was mild pain, which reflects decrease in studied patients' lower limbs' pain intensity.

These findings agree with **Rashwan et al. (2022)** whose study was about "The effect of Buerger Allen exercise versus reflexology on lower extremity perfusion and pain among patients with type 2 diabetes mellitus" which conducted in Egypt and revealed that there was a significant decreasing in level of pain post-application of Buerger's exercise interventions.

The results of the current study reported that there was a highly significant statistical difference (p ≤ 0.001) regarding **studied patients' grade of lower limbs' edema** between pre and one week after implementation of Buerger Allen exercise, where the highest percent of edema grade was grade +2 among about half of studied patients before Buerger Allen exercise implementation, that improved to be grade +1 among more than half of them one week after Buerger Allen exercise implementation.

Also, there was a highly significant statistical difference (p ≤ 0.001) between pre and one month after Buerger Allen exercise implementation, where the highest percent of edema grade was grade 0 among about three quarter of studied patients, which reflects decrease in studied patients' grade of lower limbs' edema.

These findings are in the same line with **Lakshmanan & Priya (2019)** whose study was about "Assess the effectiveness of Buerger Allen exercise to reduce pedal edema among the adults with varicose veins at Saveetha medical college and hospital" which conducted in India and revealed that the majority of studied patients had shown

significant reduction in pedal edema through Buerger Allen exercise implementation.

From the researchers point of view, the decrease in studied patients' lower limbs' pain intensity & grade of edema after practice of Buerger Allen exercise could be related to that; Buerger Allen exercise stimulates lower limbs' blood circulation and empties engorged blood vessels, so it helps to relieve associated signs & symptoms such as pain and edema.

These findings support the third research hypothesis (H3) which stated that lower limbs' pain and edema of the studied patients post implementing Buerger Allen exercise could be significantly decreased than before.

The results of the current study reported that satisfactory level of **studied patients' total practice of Buerger Allen exercise** was among the minority of studied patients before implementation of educational intervention, while improved to be among two third of them immediately after and one month after implementation of educational intervention, which reflects increase in studied patients' practice level.

From the researchers' point of view, unsatisfactory level of practice before educational intervention could be related to that; a great portion of Egyptian population does not believe in effectiveness of non-pharmacological management of diseases, while satisfactory level of practice after educational intervention reflects the effectiveness of the educational intervention that positively increased practice level.

These findings support the fourth research hypothesis (H4) which stated that mean practice scores of the studied patients post implementing educational intervention could be significantly increased than before.

These findings are in the same line with **Rawat & Gholap (2022)** who reported that there was a significant increase in mean score of patients' practice of Buerger Allen exercise after planned teaching program.

The results of the current study reported that there was a highly significant statistical positive **correlation between studied patients' total knowledge and total practice** immediately after and one month after educational intervention implementation with P-values= (<0.001, <0.001 respectively) and r ($\leq$ 0.799)**,** where the higher the level of knowledge, the higher the level of practice.

These findings agree with **Paulsamy et al. (2021)** who reported that there was a positive correlation between the knowledge and practice of the studied nurses on risk factors and prevention of varicose veins; the nurses who had better knowledge, had good practices on prevention of varicose veins.

Conclusion

The educational intervention was effective in improving patients' level of total knowledge & practice regarding lower limb's varicose veins & Buerger Allen exercise. Also, Buerger Allen exercise was effective in decreasing patients' lower limbs' pain intensity & grade of edema, as well as preventing deterioration of patients' grade of lower limbs' varicose veins and preventing complications.

Recommendations

Ongoing educational interventions are needed to improve patients' health outcomes, knowledge & practice regarding lower limb's varicose veins & Buerger Allen exercise. Further research needs to be done on larger samples from different Egyptian regions to generalize findings.

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تأثير تمرين بيرجر ألين على المخرجات الصحية لمرضى الدوالي

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تعد الدوالي الوريدية من أكثر الحالات المزمنة شيوعًا. إنها شائعة جدًا، وتؤثر على جميع الفئات العمرية من المراهقين إلى كبار السن، وتحدث بشكل كبير في الساقين. يعتبر تحسين الدورة الدموية في الأطراف السفلية عن طريق التمارين، مثل تمرين بيرجر ألين، من أكثر العلاجات غير الدوائية فعالية بين المرضى الذين يعانون من أمراض الأوعية الدموية الطرفية. لذلك هدفت هذه الدراسة إلى تقييم تأثير تمرين بيرجر ألين على المخرجات الصحية لمرضى دوالي الساقين. وقد أجريت الدراسة في عيادة الجراحة العامة بمستشفى بنها الجامعي، بنها، محافظة القليوبية، مصر، على ٦٩ من المرضى الذين يعانون من دوالي الساقين من الدرجة الثالثة. حيث كشفت النتائج أن التدخل التعليمي كان فعالاً في تحسين مستوى المعرفة والممارسة الإجمالية للمرضى فيما يتعلق بدوالي الساقين وتمرين بيرجر ألين. كما كان تمرين بيرجر ألين فعالاً في تقليل شدة الألم ودرجة التورم بالساقين، وأيضًا منع تدهور درجة دوالي الساقين ومنع المضاعفات لدى المرضى. وأوصت الدراسة بضرورة التدخلات التعليمية المستمرة لتحسين النتائج الصحية، ومعرفة وممارسة المرضى فيما يتعلق بدوالي الساقين وتمرين بيرجر ألين.