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The Effect of a Nurse-Led Intervention on Peripheral Artery Disease among Hypertensive Patients: A Quasi-Experimental Study

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ABSTRACT:

Background: Peripheral artery disease (PAD) is a condition in which blood flow to the legs becomes reduced. It is common among people with cardiovascular risk factors, including hypertension, but it may not always cause clear symptoms. Early identification is therefore important. The Ankle-Brachial Index (ABI) is a simple and non-invasive test that can help identify reduced blood flow in the lower limbs. Nurse-led education and regular support may help patients follow healthy lifestyle practices and manage PAD more effectively.

Methods: A quantitative quasi-experimental pre-test–post-test control group design was used. The study included 300 hypertensive patients from selected hospitals in Sangli District, Maharashtra, India. Participants were divided into an experimental group (150) and a control group (150) using purposive sampling. Demographic and clinical information was collected, and ABI was assessed before and after the intervention. The clinical profile included blood pressure, blood cholesterol, blood sugar, serum sodium and co-morbidities. The experimental group received a structured nurse-led intervention covering PAD education, lifestyle changes, physical activity, self-care, risk-factor management and follow-up. The control group received routine care. Paired and unpaired *t* tests were used for statistical analysis.

Results: Of the 300 participants, 186 (62.0%) were identified with PAD. Mild PAD was found in 105 (35.0%) and moderate PAD in 81 (27.0%) participants. Before the intervention, the mean ABI was 0.79 ± 0.12 in the experimental group and 0.78 ± 0.11 in the control group, with no significant difference (p=0.48). After the intervention, the mean ABI increased to 0.88 ± 0.13 in the experimental group and 0.80 ± 0.12 in the control group. The improvement was significant in the experimental group (t=10.62,

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$p<0.001$), while the control group showed no significant change ($t=1.82$, $p=0.07$). The post-test difference between groups was also significant ($t=5.67$, $p<0.001$).

Conclusion: PAD was commonly identified among the hypertensive patients studied. The nurse-led intervention was associated with significant improvement in ABI. The findings show that nurses can play an important role in PAD assessment, patient education, lifestyle guidance, self-care and follow-up.

INTRODUCTION

Peripheral artery disease is a condition in which the arteries supplying the lower limbs become narrowed or blocked, most commonly because of atherosclerosis. The condition reduces blood flow to the legs and can affect walking ability, physical activity and quality of life. More importantly, PAD is also a marker of widespread cardiovascular disease and is associated with increased cardiovascular risk. [1,2] PAD is not always easy to recognize in routine clinical practice. Some patients develop the typical symptom of intermittent claudication, while others report only leg tiredness, weakness or reduced walking ability. A proportion of patients may remain asymptomatic. Because of this, relying only on symptoms may miss patients with clinically important arterial disease. [1,2]

The worldwide burden of PAD is substantial. Song et al. estimated that more than 236 million adults were living with PAD in 2015, with the burden increasing with age. The study also identified important cardiovascular risk factors, including hypertension, diabetes, smoking and hypercholesterolemia. [2] Hypertension is particularly relevant because long-standing elevated blood pressure contributes to vascular injury and atherosclerotic changes. Patients with hypertension may also have other conditions such as diabetes, dyslipidaemia, cardiovascular disease and chronic kidney disease, which can further increase vascular risk. [3,4]

The Ankle-Brachial Index is a simple and non-invasive method for assessing lower-limb arterial perfusion. It compares systolic blood pressure measured at the ankle with systolic blood pressure measured at the arm. Current clinical guidance recognizes resting ABI as an important physiological test for establishing the diagnosis of PAD. [1,5] Identification of PAD is only the first step. Patients also require appropriate management of cardiovascular risk factors and support for healthy lifestyle practices. Structured exercise, walking programmes and behavioural support can improve walking performance and functional status in appropriately selected patients with PAD. [6-9]

Nurses have an important opportunity to contribute to this process. Regular contact with patients allows nurses to provide education, reinforce medication adherence, encourage physical activity, provide foot-care advice, monitor risk factors and support long-term self-care. Recent Indian evidence has also reported encouraging findings from nurse-led lifestyle intervention in patients with PAD. [10,11] The present study was therefore undertaken to identify PAD among hypertensive patients and to determine whether a structured nurse-led intervention could improve ABI-related outcomes.

MATERIALS AND METHODS

A quantitative research approach was used for the present study, and a quasi-experimental pre-test–post-test control group design was adopted to assess peripheral artery disease (PAD) among hypertensive patients and to evaluate the effectiveness of a nurse-led intervention. The study was conducted in selected hospitals of Sangli District, Maharashtra, India. A total of 300 hypertensive patients were included in the completed analysis, of whom 150 participants were assigned to the experimental group and 150 to the control group. The participants included in the completed study were in the age group of 40–80 years. Purposive sampling was used to select participants who fulfilled the study requirements.

The study included hypertensive patients with PAD who met the specified eligibility criteria. Patients with severe PAD, critical limb ischemia, or a history of lower-limb amputation were excluded from the study. Patients who were unwilling to provide written informed consent were also excluded. Data were collected using a structured data collection tool consisting of three sections. Section I included information related to the demographic characteristics of the participants. Section II included the clinical profile of the participants, covering blood pressure, blood cholesterol, blood sugar, serum sodium and co-morbidities. Section III consisted of the assessment of the Ankle-Brachial Index (ABI). Among the clinical conditions recorded in the study, diabetes mellitus was the most frequently reported co-morbidity, followed by cardiovascular disease and chronic kidney disease.

After the baseline assessment, participants in the experimental group received a structured nurse-led intervention designed to improve their understanding of PAD and encourage appropriate self-care practices. The intervention included education regarding PAD and hypertension, lifestyle modification, physical activity and exercise, healthy dietary practices, medication adherence, foot care, recognition of warning signs and the importance of regular follow-up. The intervention was intended to provide patients with practical information and support that could be incorporated into their daily lives. Participants in the control group continued to receive routine care without the structured nurse-led intervention.

The main outcome measure of the study was the Ankle-Brachial Index. ABI was assessed before and after the intervention to determine changes in peripheral arterial circulation and to evaluate the effect of the nurse-led intervention. The collected data were organized and analyzed using appropriate descriptive and inferential statistical methods. Frequency, percentage and mean were used to summarize the participant characteristics and ABI categories. A paired *t* test was used to compare pre-test and post-test ABI scores within the experimental and control groups, while an unpaired *t* test was used to compare ABI scores between the two groups. A *p* value of less than 0.05 was considered statistically significant.

RESULTS

The study was conducted among 300 hypertensive patients between the age group of 40–80 years who fulfilled the inclusion criteria. The subjects were selected by purposive sampling method and were divided into an experimental group (n=150) and a control group (n=150). The data were analysed using descriptive and inferential statistics.

SECTION I

Distribution of Subjects According to Demographic Variables

Table no 1: Distribution of hypertensive patients according to age n=300

Age group	Experimental (%)	Control (%)
40–49 years	30 (20.0)	32 (21.3)
50–59 years	45 (30.0)	44 (29.3)
60–69 years	43 (28.7)	42 (28.0)
70–80 years	32 (21.3)	32 (21.3)

The above table shows that among the 300 hypertensive patients, the highest proportion, **89 (29.7%)**, belonged to the age group of 50–59 years. This was followed by 85 (28.3%) patients in the age group of 60–69 years, 64 (21.3%) patients in the age group of 70–80 years and 62 (20.7%) patients in the age group of 40–49 years. The distribution of age was relatively similar in the experimental and control groups, indicating comparability of the two groups.

Table no 2: Distribution of hypertensive patients according to gender n=300

Gender	Experimental (%)	Control (%)
Male	87 (58.0)	84 (56.0)
Female	63 (42.0)	66 (44.0)

The table indicates that **171 (57.0%)** of the subjects were male and **129 (43.0%)** were female. In the experimental group, 58% were male and 42% were female, whereas in the control group, 56% were male and 44% were female.

Table no 3: Distribution according to educational status n=300

Educational status	Experimental (%)	Control (%)
Illiterate	24 (16.0)	27 (18.0)

Primary education	38 (25.3)	40 (26.7)
Secondary education	52 (34.7)	49 (32.7)
Higher secondary	21 (14.0)	19 (12.7)
Graduate and above	15 (10.0)	15 (10.0)

The findings reveal that the majority of subjects, **101 (33.7%)**, had secondary education. This was followed by 78 (26.0%) with primary education and 51 (17.0%) who were illiterate.

Table no 4: Distribution according to Occupation n=300

Occupation	**Experimental (%)**	**Control (%)**
Farmer	36 (24.0)	34 (22.7)
Government/private employee	29 (19.3)	31 (20.7)
Business	23 (15.3)	25 (16.7)
Homemaker	42 (28.0)	41 (27.3)
Retired	20 (13.3)	19 (12.7)

The table shows that 83 (27.7%) of the subjects were homemakers, 70 (23.3%) were farmers, 60 (20%) were government/private employees, 48 (16%) were involved in business and 39 (13%) were retired.

SECTION II

Clinical Profile of the Subjects

Table no 5: Distribution of Participants according to Blood Pressure n=300

Blood Pressure	**Experimental (%)**	**Control (%)**
Normal	18 (12.0)	21 (14.0)
Elevated	24 (16.0)	27 (18.0)
Stage I hypertension	63 (42.0)	60 (40.0)
Stage II hypertension	45 (30.0)	42 (28.0)

The above table shows that among the 300 participants, **123 (41%)** had Stage I hypertension, followed by **87 (29%)** with Stage II hypertension. A total of 51 (17%) participants had elevated blood pressure, while 39 (13%) had normal blood pressure at the time of assessment. The distribution of blood pressure categories was comparable between the experimental and control groups.

Table no 6: Distribution of Participants according to Blood Cholesterol Level n=300

Blood cholesterol level	**Experimental n (%)**	**Control n (%)**
Desirable (<200 mg/dL)	39 (26.0)	42 (28.0)
Borderline high (200–239 mg/dL)	66 (44.0)	63 (42.0)
High (≥240 mg/dL)	45 (30.0)	45 (30.0)

The findings show that **129 (43%)** participants had borderline-high blood cholesterol levels. About **90 (30%)** participants had high cholesterol levels, while 81 (27%) had desirable cholesterol levels. The experimental and control groups demonstrated a similar distribution of blood cholesterol levels.

Table no 7: Distribution of participants according to Blood Sugar Level n=300

Blood sugar level	Experimental n (%)	Control n (%)
Normal	51 (34.0)	54 (36.0)
Prediabetic	57 (38.0)	54 (36.0)
Diabetic	42 (28.0)	42 (28.0)

The table shows that **111 (37%)** participants had prediabetes blood sugar levels, followed by 105 (35%) with normal blood sugar levels. A total of **84 (28%)** participants had diabetic blood sugar levels. The distribution of blood sugar levels was similar in the experimental and control groups

Table 8: Distribution of participants according to Serum Sodium Level n=300

Serum sodium level	Experimental n (%)	Control n (%)
Normal	126 (84.0)	129 (86.0)
Hyponatremia	15 (10.0)	12 (8.0)
Hypernatremia	9 (6.0)	9 (6.0)

The table indicates that the majority of participants, **255 (85%)**, had normal serum sodium levels. Hyponatremia was observed in 27 (9%) participants, whereas 18 (6%) had hypernatremia. The experimental and control groups were comparable with respect to serum sodium levels.

Table 9: Distribution of participants according to Co-morbidity n=300

Co-morbidity	Experimental n (%)	Control n (%)
No co-morbidity	33 (22.0)	36 (24.0)
Diabetes mellitus	48 (32.0)	45 (30.0)
Cardiovascular disease	27 (18.0)	30 (20.0)
Chronic kidney disease	15 (10.0)	12 (8.0)
Diabetes + cardiovascular disease	18 (12.0)	18 (12.0)

The findings show that **93 (31%)** participants had diabetes mellitus as a co-morbidity, followed by 57 (19%) with cardiovascular disease. A total of 36 (12%) participants had both diabetes mellitus and cardiovascular disease. Twenty-seven (9%) participants had chronic kidney disease, while 69 (23%) reported no co-morbidity. The distribution of co-morbid conditions was relatively similar between the experimental and control groups.

SECTION III

Assessment and Identification of Pad Using ABI

Table no 8: Distribution of subjects according to ABI classification at baseline n=300

ABI classification	Frequency	Percentage (%)
Normal ABI	66	22.0
Borderline ABI	48	16.0
Mild PAD	105	35.0
Moderate PAD	81	27.0
Severe PAD	0	0.0

The table shows that among the 300 hypertensive patients assessed, **186 (62%) demonstrated PAD according to the defined ABI criteria**, comprising 105 (35%) with mild PAD and 81 (27%) with moderate PAD. A total of 48 (16%) subjects had borderline ABI and 66 (22%) had normal ABI. No subject with severe PAD was included in the final sample, consistent with the exclusion criteria.

SECTION IV

Pre-Test Assessment of Abi in Experimental and Control Groups

Table no 9: Pre-test distribution of Participants according to PAD severity n=300

PAD category	Experimental n (%)	Control n (%)
Mild PAD	54 (36.0)	51 (34.0)
Moderate PAD	42 (28.0)	39 (26.0)
Borderline ABI	24 (16.0)	24 (16.0)
Normal ABI	30 (20.0)	36 (24.0)

In the experimental group, 36% had mild PAD and 28% had moderate PAD. In the control group, 34% had mild PAD and 26% had moderate PAD. The distribution of PAD categories was relatively similar between the two groups before the intervention.

Table no 10: Comparison of pre-test mean ABI scores between experimental and control groups n=300

Group	n	Mean ABI	SD	Mean difference	Unpaired *t* value	p-value
Experimental	150	0.79	0.12	0.01	0.71	0.48 NS
Control	150	0.78	0.11			

The mean pre-test ABI score of the experimental group was **0.79 ± 0.12**, while that of the control group was **0.78 ± 0.11**. The calculated unpaired *t* value was 0.71 with a *p* value of 0.48, which was not statistically significant. Therefore, there was **no significant difference between the experimental and control groups at baseline**, suggesting that the groups were comparable before implementation of the nurse-led intervention.

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SECTION V

Post-Test Assessment of ABI

Table no 11: Post-test distribution of subjects according to PAD severity n=300

PAD category	Experimental n (%)	Control n (%)
Normal ABI	51 (34.0)	39 (26.0)
Borderline ABI	36 (24.0)	27 (18.0)
Mild PAD	48 (32.0)	57 (38.0)
Moderate PAD	15 (10.0)	27 (18.0)

The table indicates that following the nurse-led intervention, **34% of patients in the experimental group achieved a normal ABI**, compared with 26% in the control group. Only 10% of patients in the experimental group remained in the moderate PAD category compared with 18% in the control group. The findings demonstrate a shift from more severe PAD categories towards normal and borderline ABI categories in the experimental group.

SECTION VI

Comparison of Pre-Test and Post-Test ABI in Experimental Group

Table no 12: Comparison of pre-test and post-test ABI scores in experimental group n=300

Assessment	n	Mean ABI	SD	Mean difference	Paired *t* value	p-value
Pre-test	150	0.79	0.12	0.09	10.62	<0.001
Post-test	150	0.88	0.13			

The mean ABI score increased from **0.79 ± 0.12 in the pre-test to 0.88 ± 0.13 in the post-test** among patients in the experimental group. The mean difference was **0.09**. The calculated paired *t* value was 10.62 and the corresponding *p* value was <0.001, indicating a statistically highly significant improvement in ABI following the nurse-led intervention. Therefore, the nurse-led intervention was effective in improving ABI among hypertensive patients in the experimental group.

SECTION VII

Comparison of Pre-Test and Post-Test ABI in Control Group

Table no 13: Comparison of pre-test and post-test ABI scores in control group n=300

Assessment	n	Mean ABI	SD	Mean difference	Paired *t* value	p-value
Pre-test	150	0.78	0.11	0.02	1.82	0.07 NS
Post-test	150	0.80	0.12			

The mean ABI score in the control group increased slightly from **0.78 ± 0.11** at pre-test to **0.80 ± 0.12** at post-test. The mean difference was only 0.02. The calculated paired *t* value was 1.82 with a *p* value of 0.07. Since the *p* value was greater than 0.05, the difference was not statistically significant. Thus, there was no statistically significant improvement in ABI in the control group.

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SECTION VIII

Comparison of Post-Test Abi Between Experimental and Control Groups

Table no 14: Comparison of post-test ABI scores between experimental and control groups n=300

Group	n	Mean ABI	SD	Mean difference	Unpaired *t* value	p-value
Experimental	150	0.88	0.13	0.08	5.67	<0.001
Control	150	0.80	0.12			

The mean post-test ABI score was **0.88 ± 0.13** in the experimental group compared with **0.80 ± 0.12** in the control group. The mean difference was 0.08. The calculated unpaired *t* value was 5.67 with a *p* value of <0.001. This indicates a statistically highly significant difference in post-test ABI between the experimental and control groups. Therefore, the nurse-led intervention was effective in improving ABI among hypertensive patients.

SECTION IX

Overall Effectiveness of the Nurse-Led Intervention

Table no 15: Comparison of change in ABI scores between experimental and control groups n=300

Group	Pre-test Mean ABI	Post-test Mean ABI	Mean improvement	Percentage improvement
Experimental	0.79	0.88	0.09	11.39%
Control	0.78	0.80	0.02	2.56%

The experimental group demonstrated a mean improvement of **0.09 in ABI**, corresponding to approximately **11.39% improvement** from the baseline value. In comparison, the control group demonstrated only a **0.02 improvement**, corresponding to approximately **2.56%**. Thus, the improvement in ABI was substantially greater in the experimental group.

DISCUSSION

The present study identified PAD in 62% of the 300 hypertensive patients assessed. Mild and moderate PAD were the main categories observed. This finding is clinically important because PAD may remain unnoticed when patients do not report typical symptoms.

The high proportion identified in the present study is consistent with the wider evidence showing that PAD is strongly related to age and cardiovascular risk factors. Song et al. reported a substantial global burden of PAD and identified hypertension, diabetes, smoking and hypercholesterolemia as important associated factors. [2] The clinical profile in the present study also showed several cardiovascular and metabolic risk factors. Diabetes mellitus was present in 31% of participants, cardiovascular disease in 19%, chronic kidney disease in 9%, and diabetes with cardiovascular disease in 12%. These findings highlight that hypertension frequently occurs alongside other conditions that may increase vascular risk. The baseline comparison showed no statistically significant difference in ABI between the experimental and control groups. The similarity of the groups before intervention is important because it reduces the likelihood that the post-test difference was simply due to a large initial difference between groups. After the nurse-led intervention, the experimental group showed a significant increase in mean ABI from 0.79 to 0.88. In contrast, the control group showed only a small increase from 0.78 to 0.80, which was not statistically significant.

The findings are supported by recent Indian research. Santhipriya and Selvanayaki reported significant improvement in ABI and functional outcomes following a nurse-led lifestyle intervention that included education, walking, Buerger-Allen exercises and nutritional support. [10] The similarity is important because both studies emphasize the value of structured nursing support rather than one-time advice. The present findings are also consistent with evidence supporting structured exercise for PAD. The LITE randomized trial demonstrated that appropriately structured walking exercise can improve walking performance in

patients with PAD. [6] Similarly, the American Heart Association scientific statement emphasizes structured exercise as an important part of PAD management. [7]

However, evidence also shows that simply telling patients to exercise may not always be enough. The HONOR trial evaluated home-based walking supported by wearable technology and telephone coaching and did not demonstrate a significant improvement in the primary walking outcome compared with usual care. [8] This suggests that the design, intensity, adherence and monitoring of an intervention all matter.

In the present study, the greater improvement in the experimental group may therefore reflect the combined effect of education, lifestyle guidance, exercise encouragement, self-care support and continuing reinforcement rather than a single intervention component. The difference between groups was also statistically significant at post-test, with a mean ABI of 0.88 in the experimental group compared with 0.80 in the control group (t=5.67, p<0.001). This supports the study hypothesis that a structured nurse-led intervention can improve PAD-related outcomes. The findings are clinically relevant for nursing practice. Nurses are in a strong position to identify patients at risk, reinforce cardiovascular risk-factor management, encourage appropriate activity, provide foot-care education and support adherence to long-term treatment. [11] The recent ACC/AHA guideline similarly emphasizes comprehensive management, exercise, risk-factor control, preventive foot care and follow-up in PAD. [1]

CONCLUSION

The present study found a considerable burden of PAD among the hypertensive patients assessed. Among 300 participants, 186 (62%) were identified with PAD, with mild and moderate disease accounting for the majority of cases. The experimental and control groups were comparable at baseline. Following the nurse-led intervention, the experimental group demonstrated a significant improvement in mean ABI from 0.79 ± 0.12 to 0.88 ± 0.13, whereas the control group showed only a small and statistically non-significant increase from 0.78 ± 0.11 to 0.80 ± 0.12. The significant difference in post-test ABI between the two groups indicates that the nurse-led intervention was associated with better peripheral arterial outcomes than routine care.

The findings suggest that nurses can make a meaningful contribution to PAD management through early identification, patient education, lifestyle counselling, exercise guidance, self-care support, risk-factor management and follow-up. Larger multicentre studies using randomized designs and longer follow-up are recommended to confirm these findings and assess whether improvements in ABI are accompanied by better walking ability, quality of life and long-term cardiovascular outcomes.

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