

Determination of Prevalence and Risk Factors for Peripheral Arterial Disease in Hypertensive Patients Amongst the Rural Population

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ABSTRACT

BACKGROUND: Hypertension stands at the topmost rank with an overall prevalence of 33% worldwide and 29.8% all over India and is a powerful contributor to cardiovascular morbidity and mortality. It is not only a risk factor for cardiovascular diseases but also has a serious effect on blood vessels triggering damage and narrowing of arteries. For a long time, Peripheral artery disease, is being unrecognized and underestimated by the cardiovascular community. Recently the studies have shown a clear association between hypertension and Peripheral Arterial Disease. As Peripheral Arterial Disease is associated with risk of developing cardiovascular disease early diagnosis of the disease and management is important to decrease the burden on the health care system. Therefore, this study was planned to determine the prevalence and risk factors for Peripheral Arterial Disease in hypertensive individuals amongst the rural population.

METHOD: A survey study (n= 80) was conducted amongst patients aged between 50 to 70 years old diagnosed with hypertension. The recruited patients were screened as per the inclusion criteria and was further assessed for demographic data and other details (personal, medical and vascular history, general examination). The patients underwent a detailed assessment consisting of special test to determine arterial insufficiency along with Ankle-Brachial Index testing. An electronic device named Diapodo Care was used to measure ABI. The patient was diagnosed with PAD when the ABI was ≤ 0.90 .

RESULTS: The study established an overall prevalence of Peripheral Arterial Disease in 23.75% of the total recruited hypertensive patients with a positive correlation between level of physical activity and Ankle- Brachial Index and a negative relation with age, Body mass index, addiction and pulse pressure. Predisposition of disease was established on the basis of gender, age, Body Mass index (BMI), addiction, lifestyle and pulse pressure.

CONCLUSION: The study concluded that, a strong association exist between hypertension and peripheral arterial disease. And multiple risk factors such as female gender, older age, increased BMI, presence of addiction, sedentary lifestyle and elevated pulse pressure which predisposes a hypertensive individual to develop Peripheral Arterial disease. And ABI also proves to be an effective, cost efficient and time saving method to diagnose Peripheral Arterial Disease in hypertensive people.

KEYWORDS: Hypertension, Ankle-Brachial Index, Peripheral Arterial Disease, Body mass index, Addiction, sedentary lifestyle.

INTRODUCTION

Cardiovascular diseases account for a large proportion of deaths and disability around the globe ^[1]. Amongst all health-related risk factors, hypertension stands at the topmost rank with an overall prevalence of 33% world-wide and 29.8% all over India ^[2]. It is a grave, chronic medical condition that increases mortality rate from cardiovascular and renal disease ^[3]. It is noted as one of the powerful contributors to cardiovascular morbidity and mortality and is a major cause of premature death. ^[4]

Universally, hypertension is defined as blood pressure above 140/90 mm of Hg ^[5]. Its incidence is rising globally, owing to ageing of the population and an increase in exposure to lifestyle risk factors including consumption of alcohol, smoking, use of tobacco, stress, unhealthy diets (i.e. excessive sodium and low potassium intake) and sedentary lifestyle ^[3]. The prevalence of hypertension is observed to be higher in low-income countries compared to the high-income countries and higher in males compared to females, but this ratio becomes equivalent after the age of 50 ^[3].

Hypertension is determined by several factors including blood volume, arterial tone and cardiac output which in turn are affected by various genetic, environmental and neurohumoral mechanism ^[6]. One of the major contributors to the development of hypertension is oxidative stress ^[7]. It is caused due lifestyle habits such as smoking, consumption of alcohol, use of tobacco, obesity, diets high in fat, sugar, and processed food ^[7]. Increased oxidative stress damages the vascular endothelium, reduces nitric oxide production, impairs endothelium-dependent vasodilation which results in enhanced vascular tone and thus hypertension. ^[7]

Hypertension is rightly considered as a “Silent Killer” as majority of cases are asymptomatic and is extremely communal amongst older men and women ^[1]. The incidence and complications of hypertension upsurges with advancing age with prevalence rates of approximately 70% in adults over the age of 75 years ^[1]. The complications of hypertension arise due to sustained elevated blood pressure subsequently causing changes in heart and vasculature ^[8]. Altogether, amongst the 17 million deaths due to cardiovascular problems globally, the complications of hypertension accounts for 9.4 million deaths every year ^[9].

Elevated blood pressure can lead to multiple problems including Congestive Heart failure, coronary heart disease, renal failure, dissecting aneurysms, peripheral arterial disease, retinopathy, diabetes and stroke ^[8]. Therefore, the incidence of hypertension and its complications is increasing which is resulting in significant morbidity and mortality. Therefore, increasing the burden on the health-care system globally ^[1]. Hypertension, is not only a risk factor for cardiovascular diseases but also has a serious effect on blood vessels triggering damage and narrowing of arteries ^[10]. Peripheral artery disease, is being unrecognized and underestimated by the cardiovascular community for a longer period of time ^[11]. Researches have shown a clear association between hypertension and peripheral arterial disease a study found, risk of peripheral artery disease increases by 2.5 to 4 folds in men and women with hypertension ^[12]. For the first time the seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure highlights a significant finding stating that peripheral arterial disease as equivalent in risk to ischemic heart disease ^[12].

Peripheral arterial disease comprises a group of occlusive and aneurysmal disease resulting in narrowing and occlusion of peripheral arteries ^[13]. Approximately 20% of individuals affected with peripheral arterial

disease die due to cardiovascular event. The disease causes arterial insufficiency which leads to a lack of adequate blood flow to a region of body [14].

Peripheral arterial disease most commonly affects the blood supply of lower limbs [14]. An individual experience symptom depending upon how severely the blood supply is reduced and which artery is affected [14]. Initially the pain appears after walking for some distance or even after mild exercises, the severity of the symptoms upgrades as the disease advances eventually leading to critical limb ischemia [14]. PAD when left untreated, can severely debilitate a patient causing life – threatening infections in some individuals [14].

Peripheral arterial disease is a major issue world-wide which leads to loss of limb or even death [14]. Various studies have concluded that, a rise in blood pressure increases the risk of peripheral arterial disease and there is a significant association between the both [15]. Peripheral arterial disease is a clinical type of atherosclerotic disease [14]. Atherosclerosis is a chronic inflammatory disease of the arteries that is the most common pathophysiologic process underlying the cardiovascular disease, thus further explaining the link between hypertension and peripheral arterial disease [14].

A common non-invasive, sensitive screening for PAD is Ankle-Brachial Index [14]. It is a ratio of systolic blood pressure of lower-extremity to upper extremity [16]. An ABI less than 0.9 is considered as an indicative of peripheral arterial disease. The sensitivity and specificity of Ankle- Brachial index for PAD is 95% and 98% respectively [16]. Therefore, in a rural population with limited access, Ankle- Brachial Index is an effective tool to investigate the risk of PAD in population prone to develop PAD as hypertension [16].

Keeping in mind the rural scenario, literature and the upcoming challenges of the health care system the present was planned to investigate the prevalence of Peripheral Arterial Disease in hypertensive patients and to determine its risk factors so as to increase the awareness and knowledge of risk of PAD in hypertension. Further reducing the risk of PAD in hypertensive individuals and decreasing the burden on health care system.

METHODOLOGY

This was a survey study held in a rural settlement at Dr. Vithalrao Vikhe Patil Pravara Rural Hospital, Loni, Maharashtra. The study commenced after the approval from the institutional ethical committee from Apr'23 until Jan'24. The data was collected from the hypertensive patients coming to our hospital and convenient sampling method was used for the following study. 97 patients diagnosed with hypertension were screened for eligibility according to inclusion and exclusion criteria (stated below) out of which 80 patients were recruited for the study. Informed consent was taken from the recruited patients and were explained about the study and the procedure while giving them the patient information sheet.

The data collected from the recruited patients were in the form of qualitative and quantitative data. This data was obtained through the assessment proforma developed by the researcher which included demographic details, personal, medical and vascular history, level of physical activity, general along with local examination of the affected part, special test to determine arterial insufficiency and Ankle-Brachial Index testing. Ankle-Brachial Index was measured using diapodo care machine which calculates ABI using oscillometric method.

INCLUSION CRITERIA

1. All the consecutive diagnosed cases of hypertension referred from medical and surgery OPD/IPD of

Dr. Vithalrao Vikhe Patil Pravara Rural Hospital.

2. Patients between 50 to 80 years of age group.
3. Patients willing to participate and giving informed consent.
4. Patients having biochemical profiles (LDL, ESR)
5. Diabetic patients having fasting blood glucose, post prandial blood glucose, HbA1c reports (with HbA1c < 6).

EXCLUSION CRITERIA

1. Metabolic disorders (Diabetic individual with HbA1c > 6 and not having the fasting blood glucose, post prandial blood glucose, HbA1c reports, Hyperthyroidism, Hypothyroidism, Hyperparathyroidism, Hypoparathyroidism)
2. Peripheral venous disease (DVT, Varicose veins)
3. Patients with lower limb injury (leg or ankle fracture, extensive ulcer on leg)
4. Patients admitted in ICU.

OUTCOME MEASURE

Ankle-Brachial Index will be used to diagnosis peripheral arterial disease in hypertensive patients. The sensitivity and specificity of Ankle- Brachial index for PAD is 95% and 98% respectively.

RESULTS AND ANALYSIS

In this study, the data was analysed using GraphPad Instat software. Pearson Corelation test was used to assess the relation between two variables. And mean, standard deviation was calculated using the software.

Table 1: Demographics of hypertensive participants

Demographics		Percentage
Age	50-60	37.50%
	61-70	45%
	71-80	17.50%
Mean age		62.95±7.79
Gender	Female	54%
	Male	46%

Figure 1: Prevalence of Peripheral arterial disease in hypertensive individuals

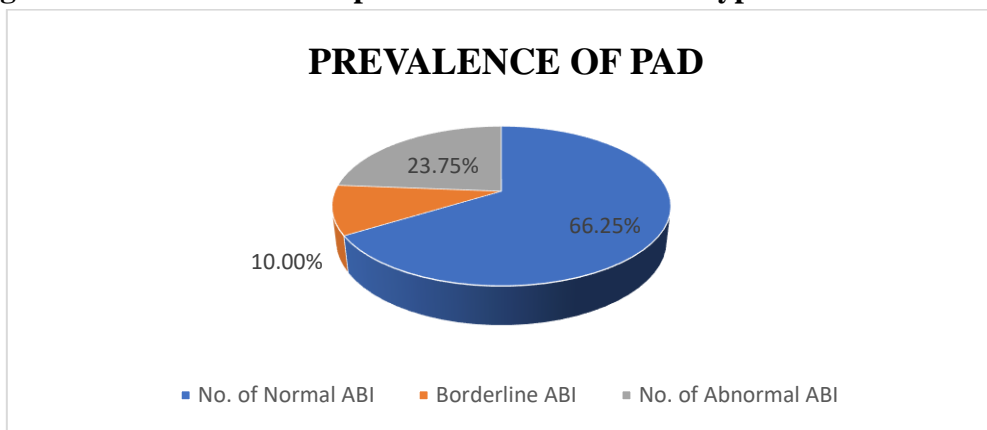


Table 2: Prevalence of Peripheral arterial disease in hypertensive individuals

Ankle- Brachial Index	Percentage
Normal ABI	66.25% (53)
Abnormal ABI	23.75% (19)
Borderline ABI	10% (18)

An overall prevalence of 23.75% of Peripheral arterial disease in hypertensive patients was seen in our study.

Figure 2: Prevalence of Peripheral arterial disease in hypertensive individuals according to gender.

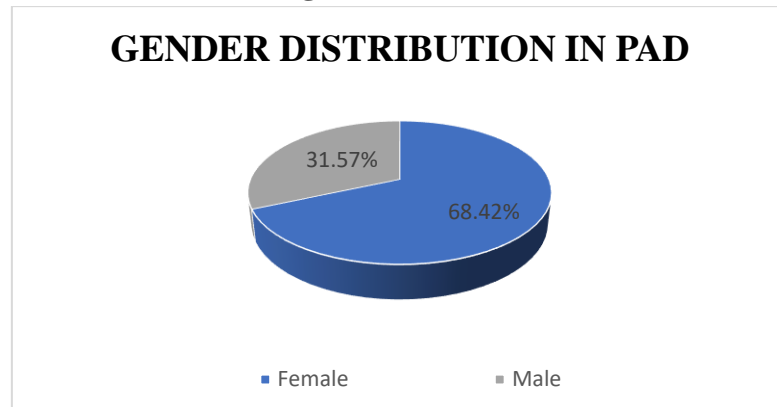


Table 3: Prevalence of Peripheral arterial disease in hypertensive individuals according to gender.

Gender	Percentage
Female	68.42% (13)
Male	31.57% (6)

A female predominance is seen with a total of 68.42% while the males hold 31.57% of the total population.

Figure 3: Prevalence of Peripheral arterial disease in hypertensive individuals according to age and correlation between abnormal ABI and Age.

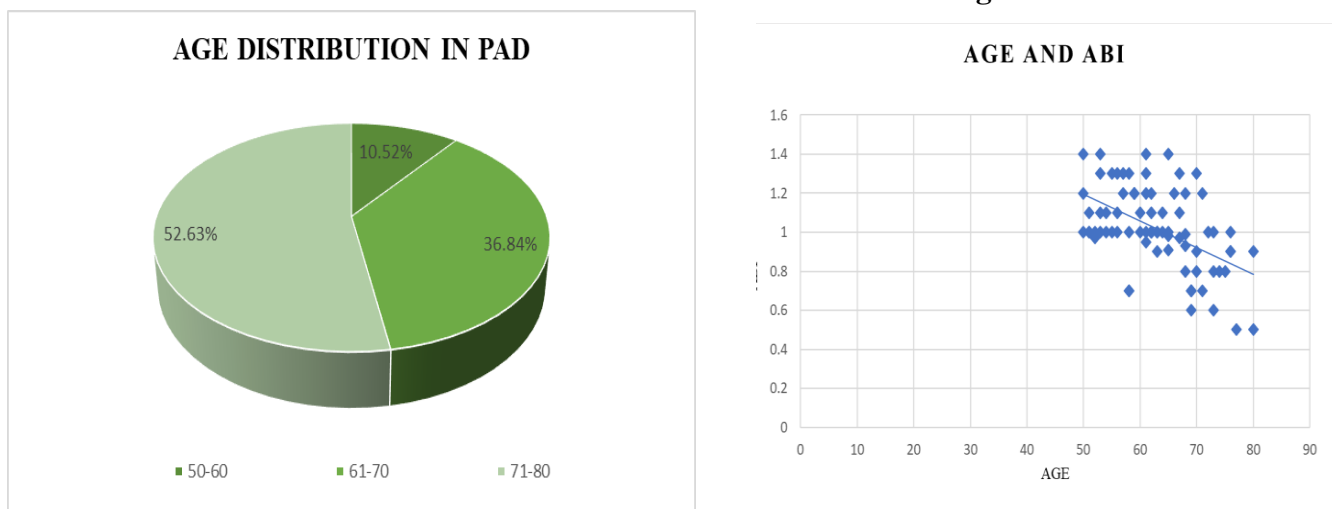


Table 4: Prevalence of Peripheral arterial disease in hypertensive individuals according to age.

Age	Percentage
50-60	10.52% (2)
61-70	36.84% (7)
71-80	52.63% (10)

The above Pie Chart and table depicts Age Distribution amongst patients with Peripheral Arterial Disease in our study. Utmost number of patients ranges between 71 to 80 years accounting for 52.63% of the total population with PAD while least share is held by the patient between 50 to 60 years (10.52%). Additionally, the $r = -0.5096$ and a p -value of < 0.0001 of both the variables (i.e age and abnormal ABI) indicates that there exists a moderately negative correlation amongst the two i.e increase in age is correlated with decrease in ABI further stating increase in age increase predisposing of Peripheral arterial disease.

Figure 4: Prevalence of Peripheral arterial disease in hypertensive individuals according to Body Mass Index and correlation between abnormal ABI and BMI.

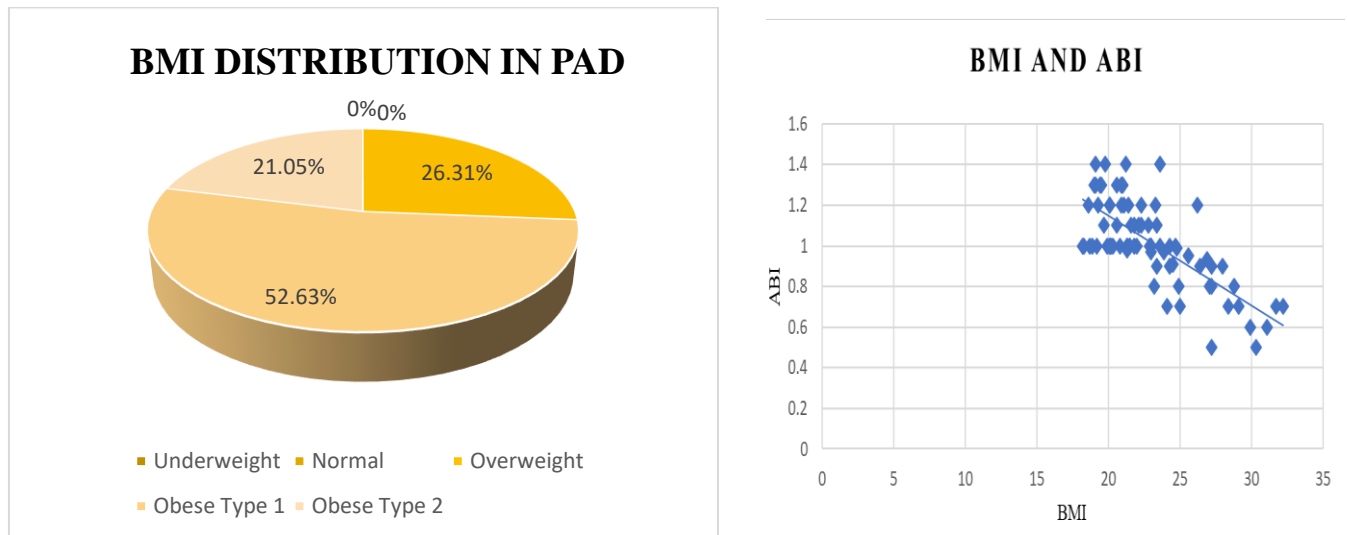


Table 5: Prevalence of Peripheral arterial disease in hypertensive individuals according to Body Mass Index.

Body Mass Index	Percentage
Underweight	0% (0)
Normal	0% (0)
Overweight	26.31% (5)
Obese Type 1	52.63% (10)
Obese Type 2	21.05% (4)

The above Pie Chart represents Body Mass Index Distribution amongst the patients with Peripheral Arterial Disease in our study. A huge percentage of patients affected with Peripheral Arterial Disease belonged to the Obese Type 1 Category (52.63%) according to the Asia-Pacific Scale of BMI. The $r = -0.7305$ value and the p value of < 0.0001 indicates that there exists a negatively strong relation amongst BMI and abnormal ABI.

Figure 5: Correlation between level of physical activity and ABI

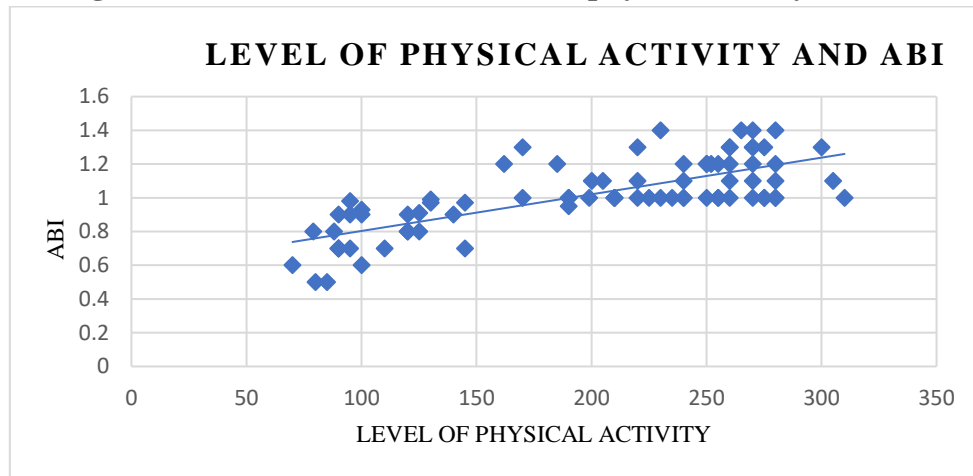
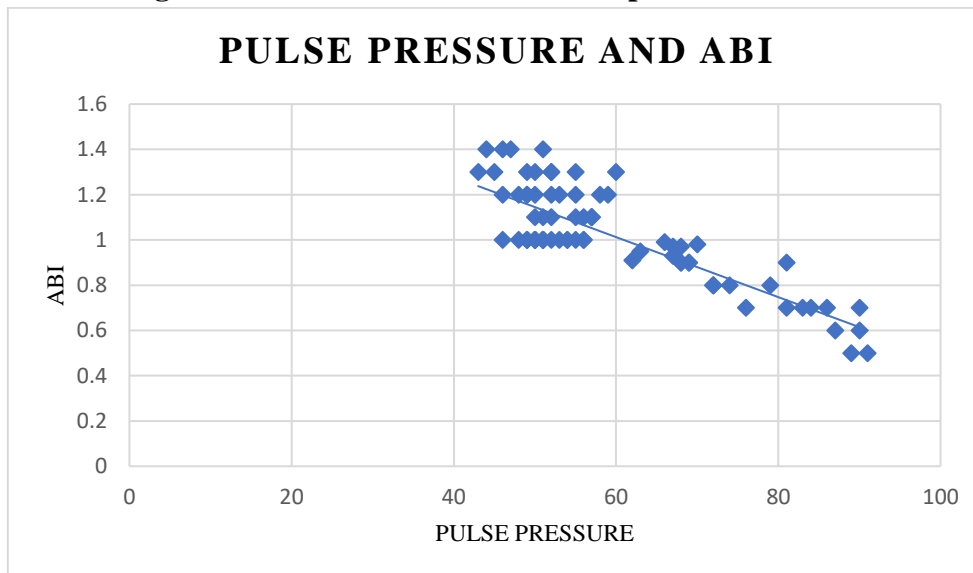


Figure 6: Correlation between Pulse pressure and ABI



In supplement to above results, a strong positive correlation was also noted between Level of Physical Activity and abnormal ABI with $r=0.7496$ and the p value being < 0.0001 . And a negative correlation was observed between pulse pressure and abnormal ABI with correlation coefficient (r) = -0.8296 and a p value of < 0.0001 .

DISCUSSION

The Present Study was conducted at Dr. Vithalrao Vikhe Patil Pravara Rural Hospital, Loni and It's constituted college Dr. APJ Abdul Kalam College of Physiotherapy. This was a Survey study conducted for a period of 6 months. The study included the hypertensive individuals from rural areas of Ahmednagar district as well as Loni village. Individuals diagnosed with hypertension between the age group of 50 to 80 years were referred from Medicine OPD of our hospital and were recruited for the study. The recruited participants were further assessed to determine the prevalence and risk factors of Peripheral Arterial Disease in Hypertensive Individuals.

Table 1 shows the demographics details of the study population with age ranging between 50 to 80 years. 45%(36) of the patients participating the study were between 61 to 70 years which accounts for a major

share in our study with a mean value of 62.95 ± 7.79 . Out of 80 recruited subjects, a female predominance was more accounting for the 56% (43) and males of 46% (37) was observed of the study Population. Out of 80 recruited subjects, a female predominance was more accounting for the 56%(43) and males of 46%(37) was observed of the study Population. It is noted that prevalence of Hypertension is higher in males at the earlier ages but as the age increases the prevalence of Hypertension surges in females especially after menopause^[17]. This change in the prevalence of hypertension amongst both the gender is credited to hormonal changes mainly the androgens levels which changes drastically in the Post-Menopausal Period^[17].

It is well-known fact that hypertension is not only a risk factor for cardiovascular disease but also has a direct effect on blood vessels^[8]. The alterations induced by persistence of hypertension can lead to the development of Peripheral Arterial Disease^[8]. Hypertension is associated with increased oxidative stress which damages the endothelium, thickens the vascular media by promoting smooth muscle cell proliferation and hypertrophy, and collagen deposition resulting in narrowing of vascular lumen thus further accelerating the process of pathogenesis of plaque^[7]. Additionally, the turbulent blood flow causes endothelial injury leading to endothelial dysfunction, inflammatory changes in the arterial wall as well as smooth muscle cell proliferation contributing to the formation of atherosclerotic plaque^[18].

In the present study, an overall prevalence of 23.75% (19) of Peripheral Arterial Disease in Hypertensive individuals was found (Table 2). The results of our study is in accordance with the results of Dr. kiran Kumar singal et.al in 2016 who found out a prevalence of 7% of PAD in hypertensive participants and further concluded, that there is a strong association between Peripheral Arterial disease and hypertension and Ankle – Brachial Index is valuable method for diagnosis of peripheral arterial disease in patients with hypertension^[16]. While A Makin et.al stated in his study that, there is evidently a clear association between PVD and hypertension although its relative risk may not be as high as for smoking or diabetes mellitus^[19].

George L. bakris et.al, in his book, “hypertension a companion to braunwald’s heart disease” 3rd edition mentioned hypertension was greatly associated with greater than two times the risk for development of peripheral arterial disease also there is a strong association with systolic blood pressure. A higher systolic blood pressure is strongly associate with development of peripheral artery disease^[20].

Sex-based differences in the manifestation of PAD may arise from sexual dimorphism in the vascular substrate in health as well as sex variation in the responses to vascular stressors meanwhile the evidence also suggests that sex chromosome plays an important role in development of vascular dysfunction and atherosclerosis^[21]. In males, endothelial dysfunction sets in around 4th decade of life whereas, impairment in endothelial function occurs about a decade later around the time of menopause which is then accelerated and similar impairment to men is seen^[21].

This explains the result of our study which shows majority of hypertensive females affected with Peripheral Arterial Disease (68.42%) (Table 3). Our study finding was also supported by past literature, Hooi JD et.al conducted a longitudinal study in 2001 which showed 73% higher incidence of PAD in women (14.2/1000 person-years) than in men (8.2/1000 person-years)^[22].

The increase in the prevalence of Peripheral Arterial Disease in hypertensive participants further describing an inverse relation between Age and Ankle-Brachial Index which was seen in our study (Figure 3). Majority of the participants affected Ankle-Brachial Index were between age range of 71-80 years holding 52.63% of the total prevalence of Peripheral Arterial Disease (Table 4). The results are similar to the results of a study conducted by Ana Maria et.al in 2022 where a total of 243 hypertensive individuals

were studied out of which 16 had occlusive and 57 had abnormal ABI the study reported a low prevalence of ideal Cardiovascular health in urban hypertensive patients with a significant association with increased age, duration of hypertension, systolic blood pressure and various other factors ^[23].

Solomon C et al in the year 2005 studied the on-risk factor for decreasing ankle brachial index in men and women of 65 years or older. A significant number of patients with peripheral arterial disease belonged to the older population ^[24].

Our results depicted majority of participants affected with peripheral arterial disease in hypertension belonged to Obese Type 1 Category according to Asia-Pacific classification showing an inverse or negative correlation between BMI and Ankle-Brachial Index (Figure 4). A study conducted by Sean P. Heffron et.al found out a prevalence rate of 27.8% in obese individuals and an association between obesity with PAD which was predominant in women, the study also concluded, that increasing BMI is an independent risk factor for PAD only in women ^[25]. Similar study conducted by Junpei Li et.al found out a U-shaped association between BMI and the risk of PAD in the Chinese hypertensive population and a significantly positive associated between BMI and with the risk of PAD ^[26].

Our study observed a positive association between level of physical activity and Ankle Brachial index thus indicating decrease in physical activity decreases the ABI value which is the clinical marker of diagnosis of PAD (Figure 5). The participants who had physical activity time of less than 150 min/week (according to WHO) were considered to have sedentary lifestyle in our study. A study conducted by Said et.al in the 2023 described the link between sedentary lifestyle and Peripheral arterial disease indicating that the relation is bi-directional i.e. Sedentary lifestyle leads to the atherosclerosis and eventually PAD and PAD symptoms causing a sedentary lifestyle. The study also stated that reduction in sedentary time reduces the PAD symptoms ^[27].

Our study observed an inverse relation between pulse pressure and Ankle-Brachial Index thus explaining that an increased pulse pressure is correlated with a decreased Ankle- Brachial Index value (Figure 6). A study conducted by Yiqiang Zhan et.al in 2007 investigated 2982 participants and concluded that, Low ABI was prevalent among elderly Chinese, and pulse pressure was positively associated with low ABI ^[28]. Similarly, a study conducted in the year 2013 by P Korhonen stated, elevated pulse pressure, smoking and male gender is a major determinant of subclinical Peripheral arterial disease ^[29].

LIMITATIONS

1. The study included a relatively small sample size.
2. We used the oscillometric method for measuring ABI although the oscillometric method tends to overestimate the ABI value compared to the standardized Doppler-derived investigation.
3. We could not use the gold standard investigation i.e colour doppler due to lack of resources.

CONCLUSION

The present study was conducted to determine the prevalence and risk factors for Peripheral Arterial Disease in hypertensive individuals. The study observed a positive correlation between level of physical activity and ABI and a negative relation with age, Body mass index, addiction and pulse pressure. Further stating it as a risk factor for developing Peripheral Arterial Disease in patients with hypertension. The study found out multiple risk factors such as female gender, older age, increased BMI, presence of addiction, sedentary lifestyle and elevated pulse pressure which predisposes a hypertensive individual to develop Peripheral Arterial disease. Therefore, a strong association between Hypertension and Peripheral

Arterial Disease has been found. And a strong effort should be made to spread the awareness about risk of developing Peripheral Arterial Disease amongst the patients with hypertension and its risk factors so as to decrease the burden on health care system and on the nation.

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Conflict of interest: None declared.

Ethical Approval: The study was approved by institutional ethics committee.

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