

Screening for Peripheral Artery Disease (PAD) in Hypertensive Black Patients: Ankle-Brachial Index in a Senegalese Primary Care Setting

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Abstract

Background: Peripheral artery disease (PAD) poses a significant health concern, particularly in Sub-Saharan Africa, where its prevalence is increasing. [1] Despite its significance, there is limited understanding of PAD among hypertensive patients in this region, highlighting a critical gap in knowledge. This study aimed to investigate the prevalence of PAD and associated factors in black hypertensive patients. **Methods:** A descriptive and analytical cross-sectional study was conducted over two years at a primary care center in Senegal using their ankle-brachial index (ABI) database. Data collection was strictly retrospective, and sociodemographic characteristics and clinical parameters were retrieved from the local patient database. We included all hypertensive patients who had benefited from an ABI. Statistical analysis was performed using the SPSS 18.0 software program. **Results:** Among the 220 hypertensive patients enrolled, PAD prevalence was 35%. Significant associations were observed between PAD occurrence and older age (>75 years, $p = 0.008$) and triple therapy ($p = 0.015$). Multivariate analysis confirmed age >75 years as a strong predictor of PAD in hypertensive patients ($p = 0.01$, OR = 4.6). Furthermore, PAD prevalence increased with the severity of hypertension ($p = 0.03$), emphasizing the need for targeted screening strategies in this population. **Conclusion:** Despite its limits, this study underscores the urgent need for improved access to healthcare services and tailored screening programs. The findings highlight the growing burden of PAD in Sub-Saharan Africa and the essential role of early detection and intervention, particularly in high-risk populations such as hypertensive individuals. Collaborative efforts involving healthcare providers, policymakers, and community stakeholders are crucial

to implement effective interventions and reduce the impact of PAD on population health outcomes.

Keywords

Peripheral Artery Disease, Hypertension, Africa South of the Sahara

1. Background

Peripheral artery disease (PAD) is a prevalent yet often underdiagnosed condition characterized by atherosclerotic narrowing of the arteries supplying blood to the lower extremities [2]. Peripheral artery disease continues to be a major public health challenge worldwide. Peripheral Artery Disease (PAD) poses a significant burden in Low- and Middle-Income Countries (LMICs), characterized by increased disability and mortality rates. The prevalence of PAD in LMICs is on the rise, with trends indicating a concerning involvement of younger adults and women [3]. 69.7% of the 202 million people living with PAD were in LMICs in 2010 [4]. Factors contributing to this burden include limited access to healthcare services, inadequate screening and diagnostic facilities, and a high prevalence of risk factors such as smoking, diabetes, and hypertension. Additionally, socioeconomic disparities exacerbate the impact of PAD in LMICs, with marginalized populations facing barriers to receiving timely and appropriate care [5].

Despite its potential severity, PAD frequently presents without symptoms, making early detection challenging. This is particularly critical in hypertensive individuals, who face an elevated risk of PAD and related complications [6]. Hypertension is a leading risk factor for cardiovascular disease (CVD), including PAD, and disproportionately affects individuals of Black ethnicity [7]. In Senegal, community-based studies showed high PAD prevalences ranging from 12.1% to 28.7% [8] [9], with a high prevalence of cardiovascular risk factors among Senegalese individuals, including hypertension and hypercholesterolemia. Thus, the present study aims to evaluate the prevalence of asymptomatic PAD in Senegalese hypertensive patients and the factors correlated with its occurrence in a primary care setting.

2. Patients and Methods

2.1. Study Design and Period

A descriptive and analytical cross-sectional study was conducted over two (2) years (from January 2021 to December 2022) at Ibra Mamadou WANE Medical Center, a primary medical setting in Dakar.

We enrolled all hypertensive patients older than 18 who had benefited from an ankle-brachial index measurement. Data collection was strictly retrospective, and we excluded all patients whose medical records were unavailable or incomplete. We identified and included all patients.

2.2. Data Collection

Socio-demographic characteristics, clinical history, and anthropometric measurements were retrieved using the local patient database. based on previous medical reports. The recorded risk factors We assessed:

- Socio-demographic parameters: age, sex, place of residence, healthcare insurance coverage, profession.
- History of , diabetes mellitus, hypercholesterolemia, or tobacco use.
- History of previous myocardial infarction (MI), angina pectoris, prior angioplasty, or coronary bypass surgery.
- Presence of hypertension as defined by a blood pressure $\geq 140/90$ mm Hg or previous treatment for high blood pressure.
- Physical examination: general condition, dyspnea according to NYHA, blood pressure, heart rate, body mass index (BMI), and waist circumference. Central obesity was defined according to the IDF criteria [10].
- Right and left ABI measurements were performed in all patients. To obtain the ABI, the systolic pressures were measured in the brachial, pedal, and posterior tibial arteries in the supine position after 5 - 10 minutes of resting. We used the auscultatory technique mediated by a Doppler Vascular ultrasound with an 8 MHZ transducer. The ABI (right and left) was considered abnormal when the ratio between the highest value of systolic pressures in the ankles and arms was ≤ 0.9 or > 1.3 mmHg. Peripheral artery disease was defined by an ABI ≤ 0.9 . PAD was considered mild to moderate for ABI values ranging from 0.41 to 0.9 and severe if ABI was ≤ 0.40 [11] [12].

2.3. Statistical Analysis

Statistical analysis was performed using the SPSS 18.0 software program. In the case of quantitative observations, baseline characteristics were presented as mean standard deviation (SD) for parameters with normal distribution. The median interquartile range was used for parameters showing no normal distribution. Categorical variables were compared using the Chi-square test or Fisher's exact test; as appropriate, continuous variables were analyzed using the Student's t-test or Mann-Whitney U test, depending on the data distribution. A P-value < 0.05 was considered statistically significant. The 95% confidence intervals of the odds ratios were determined using the Woolf method. Multivariate analysis was undertaken through binary logistic regression. All statistical analyses were conducted following ethical guidelines and data protection regulations. Data confidentiality was maintained throughout the research process.

3. Results

In total, 322 ankle systolic blood pressure measurements were conducted over two years. Out of the 322 patients, 220 were diagnosed as hypertensive, resulting in a prevalence rate of 68%. The mean age was 59.03 ± 11.4 years, with a female

predominance (51%) (Table 1). The age group most frequently represented was individuals aged 50 - 59, comprising 34% of cases. Hypertension grade 1 was more frequent in 62.8%. The duration of hypertension was more than five years in 80% of the cases. Six out of ten patients declared not to take medications regularly. Among those who were treated, 48.1% were taking dual therapy. The hypertension control rate was 40.2%. Diabetes mellitus was present in 27.9% of cases. Other cardiovascular risk factors associated with arterial hypertension included dyslipidemia (55.4%), central obesity (61.3%) and smoking (23.6%). Metabolic syndrome was observed in 13.3% of cases.

Table 1. Characteristics of our population.

Characteristics	Total (n = 220)
Age (years; mean \pm SD)	58.9 \pm 11.4
Female/Male (%)	113/107 (51/49)
History of coronary artery disease (%)	13.6
Diabetes Mellitus (%)	27.9
Hypercholesterolemia (%)	55.4
Smoking (%)	23.6
BMI (mean \pm SD)	27.3 \pm 5.84
Obesity according to BMI (%)	22.2
Waist circumference (cm; mean \pm SD)	95 \pm 14.4
Central obesity (%)	61.3
\geq 3 cardiovascular risk factors (%)	57.2
Optimal blood pressure control (%)	40.2
PAD prevalence (%)	35
High ABI prevalence (%)	1.4

The mean value of ABI was 0.96 ± 0.18 on the right and 0.96 ± 0.16 on the left. Peripheral arterial disease (PAD) was present in 35 % of hypertensive patients. PAD was mild to moderate in 76.6 % of patients. The prevalence of PAD increased with the severity of hypertension (Figure 1).

PAD was slightly more frequent in women (35.4% versus 34.1%, $p = 0.89$). PAD was less frequent in those with controlled hypertension (31.8% versus 39.4%; $p = 0.29$). The left lower limb was more frequently affected in 28.2% compared to 26.4% for the right lower limb. PAD was bilateral in 54.5% of cases. In univariate analysis, factors correlated with PAD were age > 75 years ($p = 0.008^*$), the severity of arterial hypertension ($p = 0.03^*$), and triple therapy ($p = 0.015^*$). In multivariate analysis, only age > 75 years ($p = 0.01^*$, OR = 4.6) was significantly correlated with the occurrence of PAD in hypertensive subjects (Table 2).

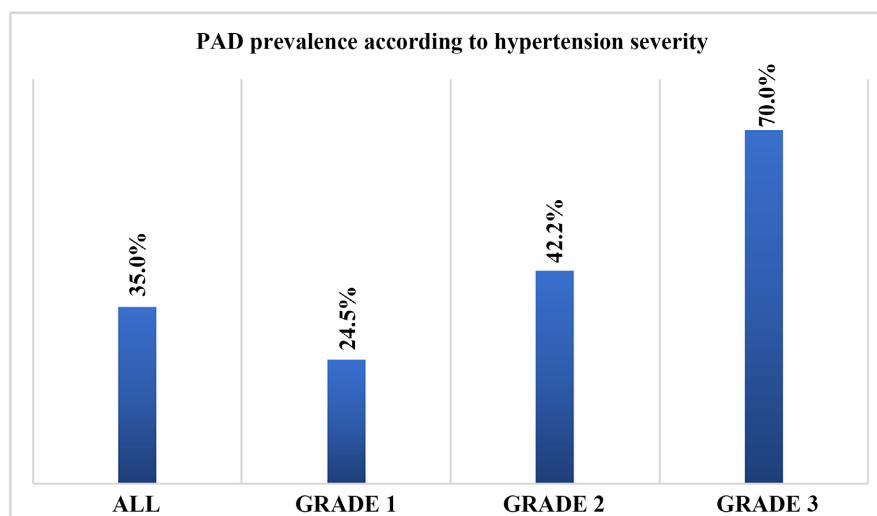


Figure 1. Prevalence of peripheral artery disease (PAD) according to hypertension severity.

Table 2. Multivariate analysis for occurrence of PAD in hypertensive patients.

	OR	CI OR 95%		P
		Inferior	Superior	
Age > 75 years old	4.602	1.434	14.766	0.010*
Diabetes mellitus	1.483	0.614	3.584	0.382
Hypertension severity	1.865	0.765	4.259	0.743
Smoking	1.438	0.630	3.283	0.389
History of coronary artery disease	1.986	0.855	4.613	0.111
Presence of >3 risk factors	0.955	0.650	1.403	0.814
Constant	0.061			0.036

4. Discussion

4.1. Key Findings

Peripheral artery disease is a worldwide issue, with the number of affected individuals increasing substantially, representing a significant public health challenge [4]. We found a high prevalence of peripheral artery disease of 35% in this black African hypertensive population. The prevalence of PAD varies across different regions, with higher rates found in LMICs compared to HICs. Song *et al.* indicate a higher prevalence of PAD in LMICs compared to HICs [13]. In a 2016 systematic review, Johnston *et al.* reported high PAD prevalence in sub-Saharan Africa, ranging from 3.1% to 24% of older adults from community-based surveys and 39% to 52% of those with known risk factors (e.g., diabetes) [1]. In Senegal, Mbaye *et al.* reported a prevalence of PAD of 28.7% in a community-based cross-sectional study in adults over 35 years, alongside a high prevalence of cardiovascular risk factors such as hypercholesterolemia (61.1%) and hypertension (48.9%) [9]. Thus,

it is essential to note that known risk factors in high-income countries (HICs) are also significant in low- and middle-income countries (LMICs). These findings suggest an increasing burden of PAD in Africa, which appears to follow the trend of cardiovascular risk factors exposure.

The present study focuses primarily on hypertensive patients. Indeed, early reports suggested that black hypertensive patients may experience more severe renal vascular involvement and a higher incidence of atherosclerotic peripheral arterial disease compared to their white counterparts [14] [15]. The prevalence of peripheral arterial disease (PAD) in hypertensive patients is indicated to be between 35% - 55%, with 35% - 55% of patients with PAD also having hypertension at presentation [16], similar to the findings of our study. This association highlights the significant overlap between hypertension and PAD in terms of co-occurrence among patients. Several risk factors influence the co-occurrence of peripheral arterial disease (PAD) and hypertension. Risk factors associated with peripheral arterial disease (PAD) in hypertensive patients include hypertension itself as a common cardiovascular risk factor, abnormalities in platelet activation and fibrinolysis, endothelial cell dysfunction, abnormal levels of hemostatic factors, increased systolic blood pressure (SBP), and a reduction in arteriolar caliber leading to total peripheral resistance [16]. Additionally, elevated oxidative stress and inflammation due to hypertension may contribute to the formation of atherosclerotic plaques, exacerbating PAD risk [16]. Other studies also report SBP ≥ 160 mm Hg, uncontrolled hypertension, older age, higher serum level of total cholesterol (TC), lower serum level of high-density lipoprotein cholesterol (HDL-C), a history of diabetes, and a history of smoking to be associated with PAD among hypertensive patients [17]-[19]. In our study, age >75 years ($p = 0.01$, OR = 4.6) was strongly correlated with PAD occurrence in hypertensive patients. In our black hypertensive population, PAD was significantly associated with older age, severity of hypertension, and uncontrolled hypertension. Our rate of hypertension control is meager (40.2%), highlighting the urgent need to improve our secondary prevention strategies. Given that hypertension is the leading cause of cardiovascular disease (CVD) in Africa [20], ensuring effective hypertension control in Africa is unquestionably one of our top priorities.

4.2. Study Limitations

Our study has several limitations. The retrospective data collection method risks incomplete or biased data. Additionally, the study's focus on a high-risk group of hypertensive individuals compromises its applicability to a broader population, further restricting the generalizability of our findings. However, these challenges highlight the importance of future research using prospective designs with long-term follow-up to improve our understanding of peripheral artery disease and its risk factors in hypertensive patients in our region.

4.3. Implications for Public Health

Despite its limitations, the findings of our study emphasize the immediate need for preventive measures, early detection strategies, and better access to healthcare services to tackle the increasing burden of PAD in Senegal. In low- and middle-income countries (LMICs) with limited health resources, governments must prioritize the management of peripheral artery disease, focusing specifically on preventing acute cardiovascular events. It is crucial to have collaborative efforts involving healthcare providers, policymakers, and community stakeholders to implement effective interventions and minimize the impact of PAD on the population's health outcomes. Additionally, more epidemiological and clinical research is needed to fully understand the scope of PAD among hypertensive patients in this region.

5. Conclusion

Our comprehensive study findings reveal that peripheral artery disease (PAD) is notably prevalent among the black population with hypertension. This condition commonly presents without symptoms, highlighting the critical need for widespread screening efforts, mainly focusing on individuals over 75 years old and those with severe hypertension. These results underscore the urgency for further in-depth research and the development of targeted interventions to effectively address the specific health challenges encountered by black hypertensive patients in sub-Saharan Africa.

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Writing - original draft: Ngone D. Gaye.

Writing - review & editing: Aliou A. Ngaide and Mame M. Ka.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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