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Prevalence and Risk Factors of Peripheral Artery Disease in a Group of Apparently Healthy Young Cameroonians: A Cross-Sectional Study

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Abstract

Background: The burden of peripheral artery disease (PAD) is not well known among apparently healthy people in Africa. **Aim:** To determine the prevalence and associated risk factors of PAD in a group of blood donors seen at the Douala General Hospital—Cameroon. **Methods:** Between 1st November 2015 and 30th April 2016, we carried out a cross-sectional study. Participants were consenting adults of both sexes, aged ≥ 21 years who presented for blood donation, and were tested HIV negative. We collected socio-demographic data and their past history. We carried out a physical examination and measured their Ankle-Brachial Index (ABI). We defined PAD as an ABI < 0.9. We also measured their fasting blood glucose and lipid profile. **Results:** We recruited 103 participants, 55.4% males. The mean age was 33 ± 10 years. The mean ABI on left and right leg was 1.04 ± 0.1 and 1.02 ± 0.1 respectively. ABI was higher in males than females both legs (p < 0.05). PAD was seen in 11 (10.7%) participants. This was higher in females than males (3.6% versus 19.2%, p = 0.026). Among those with PAD, 8 (72.7%) were asymptomatic (Males: 100% versus Females: 66%, p = 0.9). After adjusting for age and gender, sedentary lifestyle (aOR: 7.14, [95% CI: 1.38 - 33.3], p = 0.019), and female gender (aOR: 6.2, [95% CI: 1.26 - 30.5], p = 0.025) were significantly associated with PAD. **Conclusion:** The prevalence of PAD was high in this group of HIV negative blood donors, most of whom were asymptomatic. This was associated with females, and a sedentary lifestyle.

Keywords

Peripheral Artery Disease, ABI, Prevalence, Risk Factors, Douala

1. Introduction

Deaths due to cardiovascular diseases (CVDs)—estimated at 17.5 million, account for about 31% of the global mortality [1]. The substratum of CVDs is atherosclerosis, which develops with time, and only manifests at an advanced stage [2]. The complications of atherosclerosis are stroke, peripheral artery disease (PAD), ischemic heart disease, chronic kidney disease, and retinopathy. These complications have a high public health impact [3].

PAD affects 7% to 26% of adults in America [4]. Disability and mortality of PAD have increased over the past twenty years, with the greatest burden in women. There is also an increasing burden of PAD in young adults, and in those living in low-income settings [5]. This high disease burden is associated with under-diagnosis [6] [7]. Risk factors of PAD have been shown to be age, tobacco use, diabetes, chronic kidney disease, hypercholesterolemia, and HIV infection [8]-[13].

Ankle Brachial Index (ABI) is cost-effective in screening for PAD in low-income settings. It has been shown to be a good CVD risk marker [14]. The burden of PAD has not been well studied in our setting, especially in the younger population who seems to be enjoying good health. We carried out a cross-sectional study in a group of blood donors who were tested HIV negative at the blood bank of the Douala General Hospital (DGH)—Cameroon, sub-Saharan Africa. We aimed to determine the prevalence and associated risk factors of PAD in this group of people.

2. Methods

2.1. Ethical Statement

The institutional review board of the Faculty of Medicine and Pharmaceutical Sciences—University of Douala, and the administration of the Douala General Hospital (DGH) approved of this study. We carried out this work according to the declarations of Helsinki. We report this study according to the standards for reporting epidemiological studies (STROBE) checklist.

2.2. Study Design and Setting

Between 1st November 2015 and 30th April 2016, we carried out a cross-sectional descriptive and analytic study in the blood bank of the DGH. This is a tertiary health institution located in Douala—the economic capital of Cameroon, in sub-Sahara Africa. It has a catchment population of about 3.3 million inhabitants. Besides patient care, it also serves as a teaching Hospital.

2.3. Participants

We included adults of both sexes, aged ≥ 21 years, who were tested HIV negative on Determine (first rapid test) and Paracheck (Second rapid test) according to the screening algorithm in Cameroon. Participants were prospectively recruited from the blood bank. We excluded those with pedal edema, and those with extensive leg wounds that made measurement of ankle blood pressure impossible. We interviewed the participants, carried out physical examination, and measured their resting blood pressures in all four limbs. We collected 4 ml of blood for chemical analysis.

2.4. Variables

We collected data on socio-demography, and past medical history including risk factors and symptoms suggestive of PAD (intermittent claudication) using the Edinburg questionnaire [15]. Pain or discomfort in the legs that did not fulfill the Edinburg criteria was considered as an atypical pain. We measured their brachial blood pressure in both arms, after ten minutes of rest, with a Spengler aneroid sphygmomanometer and standard arm cuff size, in the dorsal decubitus position. We then measured the ankle blood pressures in the supine position using the same Spengler sphygmomanometer, and a hand held Doppler apparatus (Smart DOP 45) with a probe frequency of 8 to 10 MHz. Three measurements were taken for each limb by the same trained investigator. We measured their weight in light clothing and no shoes with a Medisina® scale balance to the nearest 0.5 kg. We measured their height with no shoes using a stadiometer to the nearest 0.1 cm. We calculated the Body Mass Index (BMI) as: Weight (kg)/Height^2 (m^2). We measured their abdominal circumference with a measuring tape, with the patients in the upright position, midway between the iliac crest and lowest rib, in the mid-axillary line to the nearest 0.1 cm.

2.5. Doppler Procedure and Measurement of ABI

We measured the ankle blood pressure with the patients in the dorsal decubitus position after 10 minutes of rest, in a calm room having a temperature of 22˚C ± 1˚C. We placed the cuff of the sphygmomanometer just above the malleolus, after applying ultrasound gel and identifying the dorsalis pedis and tibialis posterior arteries with the 8 to 10 MHz probe of a handheld Doppler apparatus. We then inflated the cuff to 20 mmHg above the disappearance of the Doppler signal. We then progressively deflated the cuff at 2 mmHg per second until the reappearance of the Doppler signal. This was registered as the systolic blood pressure at the ankle. The average of three measures was retained. We calculated the ABI as the ratio of ipsilateral brachial systolic blood pressure to the ankle systolic blood pressure.

2.6. Bio-Chemical Measurements

We measured total serum cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides after 8 hours of fasting, using enzymatic methods with an automate (Cobas C311 Roche). We measured the capillary blood glucose using a glucometer (OneTouch Ultra2).

2.7. Working Definitions

We defined PAD as an ABI < 0.9, and vascular calcifications (incompressible arteries) as an ABI > 1.3. An ABI: ≥0.9 ≤1.3 was normal [3]. For the severity of PAD, an ABI: ≥0.7 <0.9 was compensated, an ABI: ≥0.5 <0.7 was decompensated, and an ABI < 0.5 was considered as the presence of critical ischemia [16]. We defined hypertension according to the seventh Joint National Committee (JNC 7) as a systolic blood pressure ≥ 140 mmHg and or diastolic blood pressure ≥ 90 mmHg, or a patient on blood pressure lowering medicine. We defined diabetes according to the WHO as a fasting blood sugar > 1.26 g/L (7 mmol/L) on two separate measurements one week apart, or a patient on anti-diabetic agents. We defined sedentarity as lack of regular physical exercise (30 minutes three times weekly). We defined normal lipid profile according to NCEP ATP III: Normal total cholesterol < 2 g/L, LDL cholesterol < 1 g/L, HDL cholesterol > 0.4 g/L for males and > 0.5 g/L for females, and Triglycerides < 1.5 g/L. We defined BMI according to WHO-Underweight: BMI < 18.5 kg/m^2, normal weight: BMI 18.5 - 24.9 kg/m^2, overweight: BMI 25 - 29.9 kg/m^2, and obesity: BMI ≥ 30 kg/m^2. We defined abdominal obesity as waist circumference > 80 cm in females, and 94 cm in males. We defined metabolic syndrome according to the International Diabetes Federation (IDF 2005) as the constellation of at least three abnormalities—Abdominal obesity (abdominal circumference > 90 cm in males and > 80 cm in females), Raised blood pressure (SBP ≥ 130 mmHg and or DBP ≥ 85 mmHg), Fasting Blood glucose ≥ 100 mg/dl, Triglycerides ≥ 1.5 g/L, and HDL cholesterol < 0.4 g/Lin males and < 0.5 g/L in females. We defined advanced HIV disease as those in WHO class III and IV.

Apparently Healthy included individuals who did not admit to any significant disease or physical condition that prevented them from engaging in physical activity.

2.8. Sample Size Consideration

For this study, we considered a convenient sample of all consenting patients who fulfilled the inclusion criteria during the study period.

2.9. Statistical Analysis

Data are presented as mean ± standard deviation (SD) for quantitative data and counts (with percentages in brackets) for qualitative data. Comparison between males and females has been performed using Chi square and Fisher's exact tests for qualitative data, and Student-t test for quantitative data. Comparison of quantitative data between those with PAD and those without PAD has been performed using Mann-Whitney test. To determine factors associated with

PAD, we performed a multivariate logistic regression. Crude odd ratios (OR) have been calculated and adjusted for age and gender. Differences have been considered significant for $p < 0.05$. All statistics have been performed using the software IBM SPSS version 20 (SSPS Inc., Chicago, Illinois, USA) while boxplots have been drawn using the GrapheR package of R software (Version 3.0.1).

3. Results

A total of 103 HIV negative blood donors (54.4% males) were included in this study. Table 1 shows the baseline characteristics of the study participants. The mean age was 33 ±10 years (Males: 34 ± 11 versus Females: 31 ± 8 years, p = 0.190). Smoking was seen in 4 (3.9%), and alcohol consumption in 24 (23.3%) participants. Males drank more than women (p = 0.003). Sedentary lifestyle was observed in 40 (38.8%) participants, and this was higher in females (Males: 28.6% versus Females: 51.1%, p = 0.033). The prevalence of hypertension was higher in males (p = 0.041), while obesity and abdominal obesity were higher in females (p = 0.026 and p = 0.013 respectively).

Table 2 shows the classification of ABI among the study participants. PAD was found in 11 (10.7%) participants, and this was higher in females (Males: 3.6% versus Females: 19.2%, p = 0.026). Arterial calcification (high ABI > 1.3) was seen in 3 (2.9%) participants, and was similar between sexes. Among those with PAD, 8 (72.7%) were asymptomatic, and there was no sex difference (Males: 100% versus Females 66.7%, p = 0.9).

Table 3 shows the comparison of cardiovascular risk factors among patients with and without PAD. Female gender and sedentary lifestyle were significantly higher in those with PAD (p = 0.011 and p = 0.035 respectively). Other risk factors were similarly distributed (p > 0.05).

Table 4 shows the unadjusted and adjusted odd ratios (OR) of factors associated with PAD. Female gender (OR: 6.39, [95% CI: 1.31 - 31.3], p = 0.022), and sedentary lifestyle (OR: 5, [95% CI: 1.24 - 20.17], p = 0.024) were significantly associated with PAD. These associations remained significant after adjusting for age and gender (aOR: 6.2, [95%CI: 1.26 - 30.5], p = 0.025 and aOR: 7.14, [95%CI: 1.38 - 33.3, p = 0.019 respectively).

Figure 1 shows the comparison of ABI between males and females. The mean ABI of the study population was 1.04 ± 0.10 and 1.02 ± 0.10 on the left and right leg respectively. ABI was significantly higher in males than female on the left and right legs: 1.07 ± 0.09 vs. 1.01 ± 0.10, p = 0.003 for the left leg and 1.05 ± 0.10 vs. 0.98 ± 0.09, p = 0.0004 for right leg respectively.

4. Discussion

We carried out this cross-sectional and analytic study with the aim of studying the prevalence and risk factors of PAD in a group of blood donors (apparently healthy individuals, who were tested HIV negative) in the DGH. The prevalence of PAD was high, and most of those with PAD were asymptomatic. Female sex

Table 1. Baseline characteristics of the study participants.

	All (N = 103)	Female (n = 47)	Male (n = 56)	*p* value
Age (years)				
Mean ± SD	33 ± 10	31 ± 8	34 ± 11	0.19
20 - 29	49 (47.6)	25 (53.2)	24 (42.9)	
30 - 39	32 (31.1)	13 (27.7)	19 (33.9)	
40 - 50	13 (12.6)	7 (14.9)	6 (10.7)	
51 - 60	9 (8.7)	2 (4.3)	7 (12.5)	0.3
Marital status (%)				
Single	78 (75.7)	36 (76.6)	42 (75.0)	
divorced	1 (1.0)	1 (2.1)	0	
Married	22 (21.4)	10 (21.3)	12 (21.4)	
Widowed	2 (1.9)	0	2 (3.6)	0.411
Past history				
Smoking (%)	4 (3.9)	0	4 (7.1)	0.175
Alcohol (%)	24 (23.3)	4 (8.5)	20 (35.7)	0.003
Sedentary lifestyle (%)	40 (38.8)	24 (51.1)	16 (28.6)	0.033
Family history of CVD (%)	46 (44.7)	20 (42.6)	26 (46.4)	0.8
Bio-clinical parameters				
Systolic BP (mmHg)	112 ± 14	108 ± 12	116 ± 15	0.003
Diastolic BP (mmHg)	72 ± 12	69 ± 9	75 ± 14	0.02
Hypertension (%)	13 (12.6)	2 (4.3)	11 (19.6)	0.041
Blood glucose (g/L)	0.86 ± 0.11	0.87 ± 0.08	0.85 ± 0.12	0.521
Type 2 diabetes (%)	1 (1.0)	0	1 (1.8)	0.9
BMI (kg/m^2)	26.2 ± 5.5	25.6 ± 5.3	26.8 ± 5.7	0.258
Obesity (%)	11 (10.7)	9 (19.1)	2 (3.6)	0.026
Abdominal obesity (%)	12 (11.7)	10 (21.3)	2 (3.6)	0.013
Lipid disorders (%)	24 (23.3)	14 (29.8)	10 (17.9)	0.233
Total cholesterol (g/dL)	1.72 ± 0.39	1.82 ± 0.45	1.65 ± 0.33	0.107
HDL cholesterol (g/dL)	0.52 ± 0.14	0.55 ± 0.15	0.49 ± 0.13	0.1
Triglycerides (g/dL)	0.66 ± 0.37	0.54 ± 0.19	0.75 ± 0.44	0.016
LDL cholesterol (g/dL)	1.01 ± 0.30	1.05 ± 0.33	0.98 ± 0.29	0.429

CVD: cardiovascular disease; BP: blood pressure; BMI: body mass index; HDL: High-density lipoproteins; LDL: low-density lipoproteins.

Table 2. Classification of ABI among the study participants.

	All (n = 103)	Female (n = 47)	Male (n = 56)	*p* value
PAD	11 (10.7)	9 (19.2)	2 (3.6)	0.026
Low ABI: <0.7	1 (1.0)	1 (2.1)	0	0.2
Low ABI: 0.7 - 0.9	10 (9.7)	8 (17.0)	2 (3.6)	0.064
Normal: 0.9 - 1.3	89 (86.4)	37 (78.7)	52 (92.9)	0.036
High ABI: >1.3	3 (2.9)	1 (2.1)	2 (3.6)	0.9
Asymptomatic low ABI ≤ 0.9	8 (72.7)	6 (66.7)	2 (100)	-
Symptomatic low ABI ≤ 0.9	3 (27.3)	3 (33.3)	0	0.9

ABI: ankle-brachial index; PAD: peripheral artery disease.

Table 3. Comparison of cardiovascular risk factors among patients with and without PAD.

	No-PAD (n = 92)	PAD (n = 11)	*p* value
Age (years)	33 ± 10	31 ± 11	0.295
Female gender (%)	38 (41.3)	9 (81.8)	0.011
Systolic BP (mmHg)	113 ± 14	108 ± 15	0.153
Diastolic BP (mmHg)	72 ± 13	69 ± 10	0.412
Hypertension (%)	12 (13.0)	1 (9.1)	0.9
Family history of CVD (%)	39 (42.4)	7 (63.6)	0.1
BMI (Kg/m^2)	24.2 ± 3.9	24.8 ± 6.3	0.906
Obesity (%)	9 (9.8)	2 (18.2)	0.3
Metabolic syndrome (%)	1 (1.1)	0	0.7
Smoking (%)	4 (4.3)	0	0.9
Alcohol (%)	23 (25.0)	1 (9.1)	0.4
Sedentary lifestyle (%)	32 (34.8)	8 (72.7)	0.035
Lipid disorders (%)	21 (22.8)	3 (27.3)	0.9
Total cholesterol (g/dl)	1.72 ± 0.40	1.70 ± 0.31	0.9
HDL cholesterol (g/dl)	0.52 ± 0.14	0.48 ± 0.12	0.742
Triglycerides (g/dl)	0.67 ± 0.39	0.63 ± 0.23	0.9
LDL cholesterol (g/dl)	1.02 ± 0.31	0.94 ± 0.31	0.5

CVD: cardiovascular disease; BP: blood pressure; BMI: body mass index; HDL: High-density lipoproteins; LDL: low-density lipoproteins.

Table 4. Unadjusted and adjusted odd ratios (OR) of factors associated with PAD.

	Unadjusted		Adjusted	
	OR (95% CI)	*p* value	aOR* (95% CI)	*p* value
Age (years)	1.02 (1.1 - 0.95)	0.51	0.94 (0.85 - 1.04)	0.24
Female gender (%)	6.39 (1.31 - 31.3)	0.022	6.2 (1.26 - 30.5)	0.025
Hypertension (%)	0.38 (0.09 - 1.79)		0.38 (0.09 - 1.79)	
Family history of CVD (%)	2.38 (0.65 - 8.69)	0.19	0.33 (0.08 - 1.47)	0.15
Smoking (%)	NA		NA	
Alcohol (%)	3.33 (0.4 - 27.47)	0.26	1.12 (0.11 - 11.12)	0.92
Sedentary lifestyle (%)	5 (1.24 - 20.17)	0.024	7.14 (1.38 - 33.3)	0.019
Lipid disorders (%)	1.56 (0.42 - 5.54)	0.5	1.61 (0.42 - 6.2)	0.4
Total cholesterol (g/dl)	0.85 (0.23 - 3.1)	0.8	1.05 (0.19 - 5.92)	0.96
HDL cholesterol (g/dl)	1.79 (0.41 - 7.91)	0.44	0.3 (0.04 - 2.1)	0.23
Triglycerides (g/dl)	1.62 (0.45 - 5.91)	0.46	0.55 (0.1 - 2.99)	0.49
LDL cholesterol (g/dl)	1.71 (0.18 - 16.51)	0.64	0.25 (0.01 - 20.3)	0.53
BMI (kg/m^2)	1.01 (0.9 - 1.12)	0.88	0.84 (0.71 - 1.01)	0.06
Obesity (%)	2.05 (0.38 - 10.99)	0.4	1.06 (0.1 - 11.14)	0.96

*: adjusted for age and gender; CI: confidence interval; NA: non-applicable; CVD: cardiovascular disease; BP: blood pressure; BMI: body mass index; HDL: High-density lipoproteins; LDL: low-density lipoproteins.

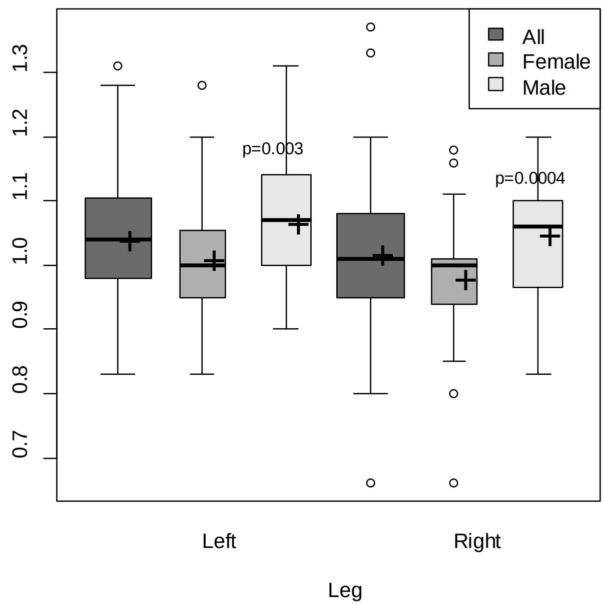

Figure 1. Comparison of ABI between male and female. The midline of the boxes represents the median and the lower and upper margins represent the 25th and 75th percentiles, respectively. The lower and upper ends represent the minimum and maximum values, respectively and the central black dot represent the mean.

and sedentarity was associated with PAD.

The prevalence of PAD in this study was higher than that reported in an older age group in high income settings. Kwiatkowska *et al.* [17] found no case of PAD in a group of people in Poland (mean age 46 years). Gupta *et al.* [18] reported PAD of 1.3% in the US (mean age 55 years). In these settings, PAD has been shown to increase with age, especially above 60 years [8]. However, [19] had a higher prevalence of PAD (16.7%). This was not surprising as his study population was different. There were fewer participants (42 participants), mean age was higher (54 years) and all had at least one known major CV risk factor. This comparison makes our findings quite pertinent as our study population was described as apparently healthy and much younger (Mean age of 34). Thus, age seems not to be an important risk factor of PAD in our setting compared to high income settings. The Genetic Epidemiology Network of Arteriopathy (GENOA) study showed that blacks were at higher risks of PAD [13]. Guerchet *et al.* [20] reported PAD in up to 32.4% in the elderly in Brazaville. Their HIV status was however not known. Female sex and sedentarity were associated with PAD in this study. Cimminiello *et al.* [7] showed that hypertension, age, alcohol use, family history of coronary heart disease, low HDL cholesterol, and tobacco use were associated with PAD in a group of patients. Sotoda *et al.* [21] reported an association of tobacco of PAD in Japanese. Houenassi *et al.* [22] showed that age, the presence and duration of hypertension, excessive weight were associated with PAD in adults in Cotonou. Hamer *et al.* [23] in a meta-analysis showed that sedentarity multiplied the risk of CVD and sudden death by two. PAD was higher in males than females, especially in the younger population. In a low-income setting, Guerchet *et al.* [20] showed a higher prevalence of PAD in older females than males.

5. Limitations

This is a single centre study in the blood bank of the Douala General Hospital. Our sample size was a major limitation, as this could reduce the power of detecting significant associations. Also, our findings cannot be extrapolated to the general population and the whole country because of the large ethnic, cultural, and geographical variabilities. This study did not capture chronic disease, which could be associated with PAD. Despite these limitations, this is the first study of the prevalence and risk factors of PAD in HIV negative apparently healthy blood donors in our setting.

6. Conclusion

We carried out this cross-sectional and analytic study with the aim of studying the prevalence and risk factors of PAD in a group of HIV negative blood donors in Douala. The prevalence of PAD was high compared to that reported in similar age groups in high income settings. Female sex and sedentarity were associated with PAD. To reduce the burden of PAD in this young population, there is the need to control vascular risk factors with emphasis on regular physical activity especially in females, while waiting for large scale community studies.

Authors' Contributions

Conception: *FK*, *YM*, *BH*, and *LH*. Design: *FK*, *YM*, *BH*, *MSD*, *GI*, *JPNM*, and *LH*. Data collection: *FK*, *YM*, *BH*, *FS*, *CK*, *FKL*, *JFK*, *IG*, *JPNM*, *MSD*, and *LH*. Data analysis and Interpretation: *FK*, *YM*, *BH*, *AMJ*, *FS*, *MSD*, and *LH*. Drafting of manuscript: *FK*, *YM*, *BH*, *FS*, *FKL*, *JFK*, *CK*, *AMJ*, *IG*, and *JPNM*. Critical review of the final draft: MSD, *LH*. All the authors approved of the final draft for publication.

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