

## Clinical research

# Prevalence of peripheral arterial disease among diabetic patients in Santo Domingo, Dominican Republic and associated risk factors

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## Abstract

**Introduction:** Peripheral arterial disease (PAD) is a major risk factor of coronary artery disease and a major complication of atherosclerosis. Peripheral arterial disease can be diagnosed with simple and low cost techniques. There are major risk factors of PAD that have been studied for different countries. However, no such study has been done for the Dominican Republic. We conducted a cross-sectional study to determine the prevalence of PAD and the risk factors among patients with diabetes in Santo Domingo, Dominican Republic.

**Material and methods:** Six hundred randomly chosen patients with previously diagnosed diabetes were enrolled in our study. Their blood pressure and ankle brachial index were calculated and a questionnaire was provided to gather information regarding gender, age, weight, ethnicity, known duration of diabetes along with any history of smoking, hypertension and hyperlipidemia. A physical examination was also done to assess for any active diabetic ulcers, previous foot ulcers and non-traumatic amputation. A micro-filament test was conducted to check for peripheral neuropathy.

**Results:** Eighty-four diabetic patients were diagnosed with PAD with a prevalence of 14% in Santo Domingo, Dominican Republic. Statistically significant associations ( $p < 0.05$ ) was found for female gender, presence of active foot ulcers, history of past foot ulcer, non-traumatic amputation, hypertension, hyperlipidemia and peripheral neuropathy. Glycated hemoglobin (HbA<sub>1c</sub>), age and smoking were not statistically significant in our study.

**Conclusions:** Diabetic patients who are either female, have active foot ulcers, a history of past foot ulcer, non-traumatic amputation, hypertension, hyperlipidemia or peripheral neuropathy are more at risk of developing PAD.

**Key words:** risk factors, diabetes, peripheral arterial disease, Dominican Republic, Santo Domingo.

## Introduction

According to the World Health Organization, cardiovascular disease is the number one cause of death in the island of the Dominican Republic [1]. There is a constant rise in the prevalence and the economic burden attributed to it keeps increasing. The epidemiologic data on the prevalence and risk factors of cardiovascular disease in the Dominican

Republic are very limited and this is in part due to the lack of proper funds and diagnostic tools. Hyperlipidemia, smoking, hypertension, diabetes and peripheral arterial disease (PAD) are the five main risk factors for cardiovascular diseases [2–5].

Peripheral arterial disease is an atherosclerotic vascular disease precipitated by the obstruction of a peripheral arterial vessel that results in ischemia [6, 7]. Patients usually present with intermittent claudication [8] and there are an estimated 8–10 million people in the USA [9, 10] and 202 million worldwide who suffer from PAD [11]. One of the major risk factors for cardiovascular disease is diabetes, and the prevalence of PAD in patients with diabetes mellitus (DM) has been found to be between 10% and 42% [12, 13], higher than the prevalence in non-diabetics, which can vary between 3% and 20% [14–19].

The prevalence of PAD in the Dominican Republic has never been studied extensively, especially in diabetic patients. Peripheral arterial disease can be diagnosed in an out-patient setting using low cost equipment by measuring the ankle brachial index (ABI). The ABI is sensitive and specific to the detection of atherosclerosis in the lower extremity vessels [20–23], making it an ideal tool in terms of cost and availability to assess the perfusion of the lower extremities. One third of the patients suffering from PAD are asymptomatic and despite its high prevalence, PAD can go undiagnosed by many doctors [24].

The aim of our study is to determine the prevalence of PAD in the Dominican Republic and the associated risk factors.

## Material and methods

A cross sectional study was carried out on diabetic patients over the age of 18 who attended the out-patient clinic at the National Institute of Diabetes affiliated to the University Iberoamericana UNIBE of the Dominican Republic in Santo Domingo, Dominican Republic between January 2012 and January 2013. Two volunteers were trained to help collect our data and the physicians, nurses as well as medical students at the hospital provided assistance.

Diabetic patients attending the clinic were randomly selected and a questionnaire was provided. Out of the 634 who participated, 600 results were properly recorded and considered for our study. The patients were interviewed by the volunteers, who also helped them fill in the questionnaires. Age, gender, ethnic group, duration of DM, presence of active diabetic foot ulcers, history of past diabetic foot ulcers and non-traumatic amputations, and history of smoking, hypertension, hyperlipidemia were all recorded. Any recall bias was avoided by cross-checking the data with the pa-

tient's file and previous visits. Results of the most recent glycated hemoglobin ( $HbA_{1c}$ ) and lipid profile within the last 6 months were also recorded.

The patients were asked to have a 5–10 min rest in the supine position and their blood pressure (BP) was recorded with a mercury sphygmomanometer. Two blood pressure measurements were recorded on each arm and the average on each side was calculated. If the difference between the two systolic BP measurements was greater than 10 mm Hg, a third recording was done.

Ankle pressures were recorded using a standardized sphygmomanometer and a Doppler ultrasonic device to accentuate the sounds over the posterior tibial and dorsalis pedis arteries.

The ankle brachial index (ABI) was calculated by dividing the average of the higher reading of the ankle pressure of the dorsalis pedis or posterior tibial artery by the average of the brachial systolic pressure of the same side [25]. Peripheral arterial disease was diagnosed if  $ABI < 0.9$ , while  $ABI > 0.9$  showed absence of the disease. The  $ABI > 1.3$  suggested possible medial arterial calcification causing partial incompressibility of the arteries.

The physicians also performed a neurological evaluation of the foot using a 10 g microfilament to test over four plantar sites for both feet as recommended by the Lower Extremity Amputation prevention program and others [26–29]. The patients were asked to say “yes” when they felt the microfilament. The presence of peripheral neuropathy was also recorded in the patients if the patients failed to say yes to at least 2 of the four spots.

## Ethics clearance

The study was reviewed and approved by the Ethics Committee of the National Institute of Diabetes affiliated to the University Iberoamericana UNIBE.

## Statistical analysis

The data were analyzed using SPSS version 24.0 (SPSS Inc, Chicago, Illinois, USA) for Windows. The  $\chi^2$  test was used to analyze for associations between categorical variables and Student's t test was used for continuous variables. Statistical significance was set at  $p \leq 0.05$ .

## Results

Our study consisted of 600 diabetic patients evenly distributed between 300 males and 300 females, 591 of whom suffered from type II DM (98.5%) and 9 from type I DM. The mean age of the patients was  $60.62 \pm 8.35$  years with a mean duration of diabetes of  $11.77 \pm 9.25$  years.

Twenty-nine patients (20 males and 9 females) had a history of non-traumatic amputation (4.8%)

and it was statistically significant ( $p < 0.05$ ). Forty-three had active foot ulcers (7.2%), among whom 31 were male and 12 were female, whereas 55 (9.2%) patients had a prior history of diabetic foot ulcers (36 male, 19 female) and both were statistically significant ( $p < 0.05$ ).

The prevalence of PAD was 14% (patients with  $ABI \leq 0.9$ ) and out of the 514 patients with  $ABI > 0.9$ , 48 had an  $ABI \geq 1.3$ , signifying the possible presence of medial calcification. Fifty-two females and 32 males were diagnosed with PAD and there was a statistically significant association between PAD and female gender ( $p < 0.05$ ). The prevalence of PAD in Hispanic Dominican diabetics was 16.8%, in Black Dominican diabetics 15.4% and in white Dominicans diabetics 10%, and no statistically significant association was found between the ethnic group and PAD. Thirty-two patients were active smokers (5.3%) and 171 were ex-smokers (28.5%). Twenty-five patients with a current or prior history of smoking were diagnosed with PAD while 59 nonsmokers were diagnosed but the difference was not statistically significant. A statistically significant association between PAD and hyperlipidemia was found with 78 patients having hyperlipidemia being diagnosed with PAD whereas only 6 were found to have PAD and a normal lipid profile. Fifty-five patients had both PAD and hypertension and 45 patients had both peripheral neuropathy and PAD and both risk factors were found to be statistically significant ( $p < 0.05$ ).

The  $HbA_{1c}$  among patients with PAD was  $9.11 \pm 2.43$  and  $8.22 \pm 2.42$  in patients without PAD and no statistical significance was found. The body mass index (BMI) of our study sample was  $33.54 \pm 7.21$  kg/m<sup>2</sup>. The results are shown in Tables I and II.

## Discussion

This study is the first major study done for the island of the Dominican Republic to assess the prevalence of PAD in the diabetic population. The calculated prevalence of 14% is comparable to other studies, which varied mostly from 10% to 15% [12, 13]. The prevalence of PAD was lower in White Dominicans than Hispanic and Blacks, but there was no statistical significance unlike previous studies [30].

In our study we found that female gender, presence of active foot ulcer, history of previous diabetic foot ulcer, non-traumatic amputations, hypertension, hyperlipidemia and presence of peripheral neuropathy were statistically proven risk factors of PAD. There are several studies that have found a similar pattern among female gender [31–34], one possible reason being the higher life expectancy of females compared to males in the Dominican Republic [35].

Smoking is strongly associated with PAD in the general population. Our study showed no significant association between PAD and smoking, which was also found in other studies [12]. The recent educational campaigns to encourage diabetics to quit smoking could have been one reason for this finding in the Dominican Republic.

A statistically strong relationship between hypertension and hyperlipidemia was found in our study and this is coherent with other studies [12, 13, 36]. 53.6% of the patients with PAD were found to have peripheral neuropathy in our study and it was statistically significant, suggesting that the presence of peripheral neuropathy increases the risk of future PAD in patients. Early detection of peripheral neuropathy can also serve to evaluate patients for underlying PAD in the future.

**Table I.** Demographics and prevalence of different conditions

Parameters (n = 600)	Values/range of values
Gender:	
Male	300
Female	300
BMI [kg/m <sup>2</sup> ]	33.54 $\pm$ 7.21
Ethnicity:	
Hispanic	482
Black	73
White	45
Age [years]:	
Mean age of patients overall	60.62 $\pm$ 8.35
Mean age of patients with PAD	62.20 $\pm$ 9.34
Mean age of patients without PAD	60.55 $\pm$ 9.22
Mean known duration of diabetes	11.77 $\pm$ 9.25
Prevalence of type 1 DM	9
Prevalence of type 2 DM	591
Smoking:	
Current smoker	32
Ex-smoker who stopped	171
Non-smokers	397
Prevalence of hypertension	498 (83%)
Prevalence of dyslipidemia	348 (58%)
Prevalence of peripheral artery disease $ABI < 0.9$ (PAD)	84

PAD – peripheral arterial disease, BMI – body mass index, DM – diabetes mellitus, ABI – ankle brachial index.

**Table II.** Association between risk factors and peripheral arterial disease in patients with diabetes mellitus in Santo Domingo, Dominican Republic

Risk factors	Prevalence of risk factors		P-value
	No PAD (n = 516)	PAD (n = 84)	
Age	60.55 ±9.22	62.2 ±9.34	Not significant
Gender:			
Female	248	52	0.018617
Male	268	32	
Ethnic group:			
Hispanic	428	72	Not significant
Black	52	8	
White	36	4	
HbA <sub>1c</sub>	8.22 ±2.42	9.11 ±2.43	Not significant
Presence of active foot ulcers (n = 43):			
Yes	28	15	0.000042
No	488	69	
History of past foot ulcer (n = 55):			
Yes	37	18	0.000027
No	479	66	
Non-traumatic amputation:			
Yes	20	9	0.006728
No	496	75	
Smoking:			
Current/ex-smoker	178	25	Not significant
Non-smoker	358	59	
Hyperlipidemia:			
Yes	270	78	< 0.00001
No	244	6	
Hypertension:			
Yes	443	55	< 0.00001
No	73	29	
Peripheral neuropathy:			
Yes	197	45	0.007654
No	319	39	

PAD – peripheral arterial disease.

Our study was done in Santo Domingo but not all of our patients lived in the city all their life. The major limitation was the small sample size of 600 patients and being restricted to one city only. The results of the HbA<sub>1c</sub> and the lipid profile were obtained from the patients' records over the last 6 months.

In conclusion, the prevalence of PAD in Santo Domingo, Dominican Republic was 14% among diabetic patients. The prevalence was slightly higher in Hispanic Dominicans and Black Dominicans compared to White Dominicans but it was not statistically significant. Statistically significant associations with PAD were found for female gender,

presence of active foot ulcers, history of past foot ulcers, non-traumatic amputations, hyperlipidemia, hypertension and peripheral neuropathy. No significant association was found with smoking, age, HbA<sub>1c</sub> levels and ethnic groups.

### Conflict of interest

The authors declare no conflict of interest.

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