

The Prevalence of Peripheral Arterial Disease in a Racially Diverse Population

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Background: The purpose of this study was to determine the prevalence of peripheral arterial disease (PAD) in white, African American, and English- and Spanish-speaking Hispanic patients.

Methods: We screened patients older than 50 years for PAD at 4 primary care clinics located in the Houston Veterans Affairs Medical Center and the Harris County Hospital District. The disease was diagnosed by an ankle-brachial index of less than 0.9. Patients also completed questionnaires to ascertain symptoms of intermittent claudication, walking difficulty, medical history, and quality of life.

Results: We enrolled 403 patients (136 whites; 136 African Americans; and 131 Hispanics, 81 of whom were Spanish speaking). The prevalence of PAD was 13.2% among whites, 22.8% among African Americans, and 13.7% among Hispanics ($P = .06$). African Americans had

a significantly higher prevalence of PAD than whites and Hispanics combined ($P = .02$). Among all patients who were diagnosed as having PAD on the basis of their ankle-brachial index, only 5 (7.5%) had symptoms of intermittent claudication.

Conclusions: Peripheral arterial disease is a prevalent illness in the primary care setting. Its prevalence varies by race and is higher in African Americans than in whites and Hispanics. Relative to the prevalence of PAD, the prevalence of intermittent claudication is low. Since measurement of the ankle-brachial index is not part of the routine clinic visit, many patients with PAD are not diagnosed unless they develop symptoms of intermittent claudication. Because of this, it is likely that many patients remain undiagnosed. Efforts are needed to improve PAD detection in the primary care setting.

Arch Intern Med. 2003;163:1469-1474

PERIPHERAL ARTERIAL disease (PAD) is atherosclerosis of the abdominal aorta and arteries of the lower extremities.¹ The most reliable and simple objective assessment of PAD is the bedside measurement of the ankle-brachial index (ABI), which is a ratio of the systolic blood pressure in the ankle to that in the arm. The disease can exist in a clinically asymptomatic or symptomatic form. Asymptomatic PAD denotes objective evidence of arterial occlusion without leg symptoms. Symptomatic PAD denotes evidence of leg occlusion and the presence of symptoms that include intermittent claudication, rest pain, ulcers, and gangrene.

The diagnosis of PAD can be made by an assessment of symptoms and/or an objective assessment of limb blood pressure. In one prior cohort study,² PAD detection was based solely on the presence of claudication symptoms. Because of the low sensitivity and specificity of this method, more recent cohort studies have used the objec-

tive ABI measurement along with ascertaining the presence of claudication.^{3,4} The prevalence of PAD and its associated morbidity remain understudied among ethnically diverse populations. The purpose of this study was to determine the prevalence of PAD among a diverse patient population that included Spanish-speaking patients and was followed at 4 primary care clinics at or near Houston, Tex.

METHODS

RECRUITMENT STRATEGIES

The institutional review board of the Baylor College of Medicine approved this study. We screened patients from the Houston Veterans Affairs Medical Center and 3 primary care clinics within the Harris County Hospital District from September 2000 through August 2001. For each medical center and prior to the date of each patient's enrollment, we obtained a clinic printout of all patients who were scheduled for an appointment with their primary care clinician.

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Only patients who had a primary care provider were identified. A primary care provider was defined as any practitioner providing general outpatient medical care. Patients were initially eligible for inclusion if they were 50 years or older. Three months into the screening, however, we assessed the number of patients diagnosed as having PAD and found that among 50 participants, none of the 17 between the ages of 50 and 54 years had PAD. Therefore, although these 17 patients were included in our analyses, the screening age for study entry was increased to 55 years or older. In addition, patients were only entered into the study if they self-identified as African American, white, or Hispanic (English speaking or Spanish speaking). Criteria for exclusion were inability to complete a consent form in either English or Spanish; dementia; chronic obstructive pulmonary disease requiring oxygen; a recently diagnosed malignancy other than skin cancer with pending or ongoing treatment; leg ulcers or gangrene; inability to provide a contact telephone number; or residence outside Texas.

All patients who were approached at the time of their clinic visit completed a screening form. Patients who were eligible and willing to participate then signed a consent form. Patients were subsequently enrolled and screened for PAD using the ABI. They also completed the San Diego Claudication Questionnaire (SDCQ),³ the Walking Impairment Questionnaire (WIQ),⁵ the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36),⁶ and the Lifestyle and Clinical Survey—a complete health history questionnaire developed by and available from the principal investigator.

MEASUREMENT OF THE ABI

Peripheral arterial disease was defined by an ABI below 0.9. A 5-mHz handheld Doppler device (Elite-100R; Nicolet Vascular Inc, Golden, Colo) with an attached stethoscope was used to measure systolic blood pressures at rest in both brachial arteries and in the dorsalis pedis and posterior tibial arteries. All patients rested in the supine position for 5 minutes before the blood pressures were taken. Appropriately sized blood pressure cuffs were placed over each brachial artery and above each malleolus. The ABI was calculated for each leg by dividing the higher ankle pressure by the higher brachial pressure. If the ABI of either leg was less than 0.9 (normal, 0.9-1.3), the patient was diagnosed as having PAD. All patients completed all questionnaires whether or not they had the disease.

MEASUREMENT OF LEG SYMPTOMS AND COMORBIDITIES

Each of the 4 questionnaires provided additional useful information about our cohort. To detect intermittent claudication, we used the SDCQ,³ which can be completed within 5 minutes. It is an expansion of the World Health Organization/Rose Questionnaire combined with a validated 9-item questionnaire. In addition to questions about the time of onset and cessation of leg discomfort, the SDCQ specifically asks whether the symptoms are present in the right, left, or both legs. For our study, we placed patients in 3 symptom categories: no pain, atypical leg pain (ie, noncalf exercise leg pain and “non-Rose” exercise calf pain), and Rose claudication. The patient’s claudication was categorized based on the most severely symptomatic leg, with Rose claudication as the most severe symptom, atypical leg pain as a less severe one, and no pain as the least severe.

In addition to leg symptoms, we obtained information on walking impairment using the clinically validated WIQ.⁵ The WIQ, which usually requires approximately 5 minutes for completion, is a simple means of assessing patient-reported walking ability. It was developed for use in large epidemiologic stud-

ies to replace the more time-consuming exercise treadmill testing. The WIQ estimates walking speed as well as walking distance and stair-climbing capacity in everyday life.

To determine health-related quality of life, we used the previously validated SF-36.⁶ The SF-36 contains 36 items with scales that measure 8 health domains: physical function, role limitations (physical problems), pain, social functioning, mental health, role limitations (emotional problems), vitality, and general health perceptions. The individual SF-36 scales are scored using the Likert method of summated ratings.⁷ A multi-item scale score is then computed by simply summing the scores assigned to item responses and by transforming scores to a 0 to 100 scale.^{8,9}

We ascertained past medical history of cardiovascular disease, atherosclerotic risk factors, process of care (eg, medication use), and sociodemographics using the Lifestyle and Clinical Survey. This is an interviewer-administered questionnaire that requires less than 10 minutes to complete. Validation of this survey using chart data is under way.

Because we screened both English- and Spanish-speaking patients, the SDCQ, the WIQ, and the Lifestyle Clinical Survey were translated into Spanish by our team of bilingual research assistants and investigators; SF-36 had been previously translated by an outside service. The translation process involved 1 forward and 2 backward translations; the backward translations were blinded. All bilingual translators then decided on a final Spanish version for each of the questionnaires.

RESULTS

Using the clinic printouts, we identified approximately 10% of all patients scheduled for an appointment with their primary care provider. We approached a total of 457 patients, and 403 patients were enrolled. Of the patients who were approached and refused participation, 51.8% were African American, 20.4% were Hispanic, and 27.8% were white ($P=.03$). The mean \pm SD age of the patients who were screened but not enrolled was 58.3 ± 21.1 years. We enrolled 151 patients from the Houston Veterans Affairs Medical Center and the other patients were from 3 sites within the Harris County Hospital District. Of the 403 patients enrolled, 67 (16.6%) had PAD and 34 (50.7%) had disease in both legs. Among the patients who were enrolled early on and younger than 55 years, 8 were white, 6 were African American, and 3 were Hispanic ($P=.34$). The mean \pm SD age of the patients who were enrolled and found to have PAD was 65.3 ± 0.85 years, and the mean age of patients without PAD was 63.5 ± 0.40 years ($P=.06$) (**Table 1**). The population was similarly divided by race, with 136 whites, 136 African Americans, and 131 Hispanics. Eighty-one (61.8%) of the Hispanic patients were Spanish speaking; of these, 30 were male and 51 female.

The disease was more prevalent in African Americans (22.8%) than in whites and Hispanics (13.5%), both English and Spanish speaking ($P=.02$) (Table 1). Among women, the prevalence of PAD was 9.1% for whites, 21.9% for African Americans, and 14.1% for Hispanics ($P=.11$). Among men, the prevalence of PAD was 16.1% for whites, 24.1% for African Americans, and 13.3% for Hispanics ($P=.29$).

The mean ABI was 0.72 ± 0.02 in patients with PAD and 1.13 ± 0.01 in patients without PAD ($P<.001$)

Table 1. Demographics of the Cohort

Characteristic	Total Cohort (N = 403)	Patients With PAD (n = 67)	Patients Without PAD (n = 336)	P Value
Race and ethnicity, No. (%)				
White	136 (33.8)	18 (13.2)	118 (86.8)	.06
African American	136 (33.8)	31 (22.8)	105 (77.2)	
Hispanic*	131 (32.5)	18 (13.7)	113 (86.3)	
Race and ethnicity, No. (%)				
White/Hispanic*	267 (66.2)	36 (13.5)	231 (86.5)	.02
African American	136 (33.8)	31 (22.8)	105 (77.2)	
Age, mean ± SD, y	63.8 ± 0.36	65.3 ± 0.85	63.5 ± 0.40	.06
Sex, No. (%)				
Men	195 (48.4)	34 (50.7)	161 (47.9)	.67
Women	208 (51.6)	33 (49.3)	175 (52.1)	
Income, \$, No. (%)				
<5000	65 (16.3)	12 (17.9)	53 (16.0)	.14
5000-30 000	253 (63.4)	44 (65.7)	209 (63.0)	
30 000-50 000	30 (7.5)	3 (4.5)	27 (8.1)	
≥50 000	20 (5.0)	0	20 (6.0)	
Declined to answer or unknown	31 (7.8)	8 (11.9)	23 (6.9)	

Abbreviation: PAD, peripheral arterial disease.

*Includes both English- and Spanish-speaking patients.

(**Table 2**). There was no difference by race in the mean ABI for patients with and without PAD. Smoking was more prevalent in patients with PAD (29.9%) than in patients without PAD (16.7%; $P = .02$). The prevalence of diabetes mellitus (DM) was 55.2% in patients with PAD vs 34.5% in patients without PAD ($P < .001$). As the ABI can be falsely elevated in patients with DM who have non-compressible tibial arteries, we determined the proportion of our patients with and without DM who had an ABI higher than 1.3. Twenty-three (15%) of our patients with DM had an ABI higher than 1.3 and 40 (16%) of our patients without DM had an ABI higher than 1.3 ($P = .79$). The prevalence of hypertension was greater in patients with PAD (82.1%) than in patients without the disease (66.4%; $P = .01$). The use of antiplatelet therapy (ie, aspirin) was not statistically different between patients with and without PAD (38.8% vs 31.9%, respectively; $P = .27$).

Among patients with PAD, 17.9% reported a history of this diagnosis. Patient awareness of a previous diagnosis of PAD differed by race (38.9% for whites, 12.9% for African Americans, and 5.6% for Hispanics; $P = .02$). The use of antiplatelet therapy did not differ significantly by race for patients with PAD (39.0% for whites, 30.5% for African Americans, and 25.7% for Hispanics; $P = .09$) (**Table 3**). Among patients with PAD, the prevalence of hypertension was 90.3% for African Americans, 77.8% for whites, and 72.2% for Hispanics ($P = .24$); and a history of DM was reported in 48.4% of African Americans, 44.4% of whites, and 77.8% of Hispanics ($P = .08$).

The prevalence of leg symptoms was statistically different among patients with and without PAD (**Table 4**). Thirty-seven percent of patients with PAD had no leg symptoms, while 49.4% of patients without PAD had no leg symptoms ($P = .006$). Atypical leg symptoms were present in 55.2% of patients with PAD and 49.1% of patients without PAD. The prevalence of intermittent claudication was 7.5% in patients with PAD vs 1.5% in patients without PAD.

Table 2. Medical History and Physical Activity of Patients With PAD vs Patients Without PAD

	Patients With PAD	Patients Without PAD	P Value
Ankle-brachial index, mean ± SD	0.72 ± 0.02	1.13 ± 0.01	<.001
Smoking status, No. (%)			
Current smoker	20 (29.9)	56 (16.7)	.02
Past smoker	26 (38.8)	130 (38.7)	
Never smoked	21 (31.3)	150 (44.6)	
Medical history			
Diabetes mellitus	37 (55.2)	116 (34.5)	<.001
Hypertension	55 (82.1)	223 (66.4)	.01
Elevated cholesterol	30 (44.8)	153 (45.5)	.91
Myocardial infarction	11 (16.4)	37 (11.0)	.21
Stroke	7 (10.5)	19 (5.7)	.14
Systolic blood pressure, mean ± SD, mm Hg	156.5 ± 3.1	145.4 ± 1.2	<.001
Antiplatelet therapy, No. (%)*	26 (38.8)	107 (31.9)	.27
Blood pressure medication, No. (%)	56 (83.6)	211 (62.8)	.001
Hormone replacement therapy, No. (%)†			
Current user	10 (30.3)	43 (24.6)	.31
Past user	6 (18.2)	55 (31.4)	
Never used	17 (51.5)	77 (44.0)	
Daily walking‡	21 (31.3)	108 (32.1)	.90
Daily exercise§	9 (13.4)	86 (25.6)	.03

Abbreviation: PAD, peripheral arterial disease.

*Antiplatelet therapy includes the use of aspirin, ticlopidine, and/or clopidogrel.

†Women only, n = 208.

‡Longer than 10 minutes without stopping.

§Such as swimming, biking, and golfing for at least 20 minutes.

Mean ± SD WIQ walking distance scores were lower in patients with PAD than in patients without PAD (43.3 ± 5.1 vs 60.4 ± 2.2 ; $P = .001$) (Table 4). Similarly, the WIQ stair climbing scores were lower in patients with PAD than in patients without PAD (40.3 ± 4.8 vs 50.6 ± 2.1 ;

Table 3. Medical History for 67 Patients With PAD by Race

	White	African American	Hispanic	P Value
Smoking status, %				
Current smoker	38.9	32.3	16.7	.27
Past smoker	44.4	38.7	33.3	
Never smoked	16.7	29.0	50.0	
Medical history, %				
Diabetes mellitus	44.4	48.4	77.8	.08
Hypertension	77.8	90.3	72.2	.24
Elevated cholesterol	44.4	45.2	44.4	1.00
Myocardial infarction	33.3	12.9	5.6	.06
Stroke	11.1	12.9	5.6	.71
PAD	38.9	12.9	5.6	.02
Systolic blood pressure, mean \pm SD, mm Hg	151.4 \pm 6.2	159.2 \pm 4.5	156.9 \pm 5.7	.59
Antiplatelet therapy, %	27.8	48.4	33.3	.31
Blood pressure medication, %	72.2	93.5	77.8	.11

Abbreviation: PAD, peripheral arterial disease.

Table 4. Prevalence of Leg Symptoms and Mean Walking Impairment Scores

	Patients With PAD	Patients Without PAD	P Value
Symptoms, No. (%)			
None	25 (37.3)	166 (49.4)	.006
Atypical leg symptoms*	37 (55.2)	165 (49.1)	
Intermittent claudication	5 (7.5)	5 (1.5)	
WIQ subscale score, mean \pm SD†			
Walking distance	43.3 \pm 5.1	60.4 \pm 2.2	.001
Walking speed	40.5 \pm 4.7	48.3 \pm 1.8	.09
Stair climbing	40.3 \pm 4.8	50.6 \pm 2.1	.04

Abbreviation: PAD, peripheral arterial disease.

*Leg discomfort other than intermittent claudication, as defined by the San Diego Claudication Questionnaire.³

†Walking Impairment Questionnaire (WIQ) subscale units are the percentage of the patient's walking ability relative to the maximum for each component.⁵

$P = .04$). There was no statistically significant difference, overall or by race, in walking speed between patients with and without PAD.

Health-related quality-of-life scores were lower for patients with PAD than for those without PAD in 2 of the 8 domains: physical function and role limitations (physical problems). The mean \pm SD score for physical function were 45.1 \pm 3.6 vs 56.9 \pm 1.6 for patients with and without PAD, respectively ($P = .003$). For role limitations (physical problems) scores were 26.2 \pm 4.7 for patients with PAD vs 43.2 \pm 2.3 for patients without PAD ($P = .002$). We calculated 2 additional scores, a physical summary scale score and a mental summary scale score, for patients with and without PAD. Physical summary scale score were lower for patients with PAD (32.1 \pm 1.3) than for patients without PAD (37.3 \pm .63) ($P < .001$). There was no statistically significant difference in the mental summary scale score between patients with PAD (51.0 \pm 1.5) and patients without PAD (48.1 \pm .69) ($P = .09$).

The prevalence of PAD within our entire cohort was comparable with that found in other studies, ie, 18% in men and women 55 years and older in general medical practices.^{4,10,11} What our study adds is additional information on the prevalence of the disease among 3 racial groups—it included Spanish-speaking patients—from lower-income households receiving care at general medical practices.

In our cohort, there was a higher prevalence of PAD in African Americans than in whites and Hispanics, both English and Spanish speaking. A higher prevalence of PAD in African Americans is consistent with results from the Cardiovascular Health Study, also based on an ABI less than 0.9.⁴ The prevalence of disease among whites within our cohort (13.2%) was also similar to that found in prior studies that used the ABI to assess the prevalence of PAD.^{4,12} The prevalence of the disease is similar among Hispanics and whites. Two prior studies, a study involving nursing home patients and a multicenter study conducted among US primary care practices, also demonstrated a similar prevalence of PAD among whites and Hispanics.^{13,14}

As the objective measurement of the ABI determines both asymptomatic and symptomatic PAD, we used the SDCQ to determine the prevalence of intermittent claudication. We found it to be low relative to the prevalence of PAD, and similar to that found in prior studies.^{12,15-18} Intermittent claudication as a diagnostic tool for PAD (as in the Rose claudication questionnaire) has a low sensitivity and a somewhat low positive predictive value compared with the gold standard of ABI for PAD.¹⁹ In addition, few individuals with a low ABI report classic intermittent claudication in spite of the improved questionnaires used to detect symptomatic PAD. Reasons for the lack of sensitivity of claudication questionnaires include the late onset of symptoms relative to the degree of arterial obstruction and the coexistence of other illnesses (eg, arthritis and congestive heart failure) that may limit walking ability and mask any underlying leg symptoms.²⁰ The presence of symptoms of intermittent claudication in our patients without PAD demonstrates that functional limitations can occur in those with a normal ABI at rest. These functional limitations are likely due to other limb disabilities, or to PAD that would be determined only by an ABI obtained following exercise. A similar feature among the 3 racial groups, the absence of leg symptoms in one third of patients with PAD means that many patients with PAD remain undiagnosed until they are referred to the vascular laboratory for diagnostic studies when physicians rely solely on symptoms of intermittent claudication.

Aside from leg symptoms, patients with PAD have a significantly increased risk of developing new coronary events and of dying from cardiovascular disease. This is an important finding for patients with PAD, symptomatic or not. For patients with an ABI of less than 0.85, the relative risk of mortality at 10 years has been found to be 2.4 (95% confidence interval, 1.60-3.48).²¹ Because patients with PAD are at increased risk for all-cause mortality, and for cardiovascular morbidity as well as

mortality, underdiagnosis of this disease, particularly in the populations most at risk, may lead to inadequate process of care (ie, lack of use of antiplatelet therapy) and inadequate risk reduction for cardiovascular events. The Clopidogrel Versus Aspirin in Patients at Risk of Ischemic Events trial²² demonstrated the benefits of antiplatelet therapy, most notably clopidogrel, in reducing myocardial infarction, ischemic cerebrovascular accidents, and vascular death in patients with PAD.

The low use of antiplatelet therapy within our cohort is all the more concerning because there was a high prevalence of atherosclerotic risk factors. The low use of antiplatelet therapy among patients at risk for cardiovascular events was recently demonstrated in 2 separate studies by Hirsch et al.^{14,23} Even more troubling was the similar rate of reported use of antiplatelet therapy among our PAD and non-PAD patients. Reasons for this may include the patients' lack of understanding of the function of their medications or the physicians' lack of awareness of the presence of disease. In addition, physicians may not be fully aware of the medications that all patients with PAD should receive unless there is a contraindication. The finding of a reduced ABI in clinic patients could alert clinicians about the possible presence of PAD and prompt them to increase the appropriate use of antiplatelet therapy. From our data, it does not appear that the clinicians' awareness of the presence of atherosclerotic risk factors (eg, smoking, DM, and hypertension) results in the appropriate use of antiplatelet therapy.

Finally, an additional reason to use the ABI as a screening tool for patients at risk for PAD is the improvement of their overall quality of life. Concerns about quality of life are important when considering any chronic illness. Patients with PAD experience both disease-specific functional limitations and overall reduced quality of life.²³ By using the ABI, physicians can identify patients with functional limitations (ie, intermittent claudication or atypical leg symptoms) due to PAD and prescribe exercise rehabilitation. Exercise therapy has been shown to improve pain-free walking distance and maximal walking distance in patients with symptomatic PAD.²⁴⁻²⁷ Exercise therapy also has the potential to favorably impact other cardiovascular risk factors. The limiting factor for this therapy is that it is most effective when supervised or when used by a highly motivated patient.²⁷ Additional work is also needed to determine the benefits of exercise therapy and the interventions necessary to increase its use in patients with PAD.

Limitations of this study include those of cross-sectional designs and their inability to assess causal association. However, this design was appropriate for determining the prevalence of disease within our study population. While our population did not include patients from higher-income households, the information gained from this small study can be used to design a larger study that will include patients from diverse socioeconomic backgrounds. Also, we did not have chart information to validate our findings, but self-report of many atherosclerotic risk factors has been used in prior epidemiologic studies. The information we provide should heighten physicians' awareness of the prevalence of PAD

among patients who are routinely seen in a primary care setting.

Peripheral arterial disease is a common illness with associated morbidity and mortality that spans across several ethnic groups and is higher in African Americans than in whites and Hispanics. The disease often remains unrecognized because physicians' and patients' awareness of the possibility of the disease, and of the need for an ABI, still mostly depends on symptoms, notably intermittent claudication. One key point is that the primary care physician and/or support staff can perform the ABI. Patients older than 55 years who are African American or have a history of smoking, DM, or hypertension should be considered for ABI screening in addition to being older and African American. As the population ages, the prevalence of PAD will increase along with its associated complications. Continued efforts are needed to increase physicians' and patients' awareness of PAD and its management.

Accepted for publication September 16, 2002.

This study was supported by the Robert Wood Johnson Minority Medical Faculty Development Program and by the Houston Center for Quality of Care and Utilization Studies, Houston Veterans Affairs Medical Center.

This study was presented in part at the 20th Annual Meeting of the Veterans Affairs Health Services Research and Development Service, Washington, DC, February 14, 2002.

The views expressed in this article are those of the authors and do not necessarily represent the views of the US Department of Veterans Affairs or Baylor College of Medicine.

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