

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION



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Circulation 2007;116;2086-2094; originally published online Sep 17, 2007;

DOI: 10.1161/CIRCULATIONAHA.107.725101

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214

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Gaps in Public Knowledge of Peripheral Arterial Disease The First National PAD Public Awareness Survey

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Background—Lower-extremity peripheral arterial disease (PAD) is associated with decreased functional status, diminished quality of life, amputation, myocardial infarction, stroke, and death. Nevertheless, public knowledge of PAD as a morbid and mortal disease has not been previously assessed.

Methods and Results—We performed a cross-sectional, population-based telephone survey of a nationally representative sample of 2501 adults ≥ 50 years of age, with oversampling of blacks and Hispanics. The survey instrument measured the demographic, risk factor, and cardiovascular disease characteristics of the study population; prevalent leg symptoms; PAD awareness relative to atherosclerosis risk factors and other cardiovascular and noncardiovascular diseases; perceived causes of PAD; and perceived systemic and limb consequences of PAD. Respondents were 67.2 ± 12.6 years of age with a high prevalence of risk factors but only a modest burden of known coronary or cerebrovascular disease. Twenty-six percent of respondents expressed familiarity with PAD, a rate significantly lower than that for any other cardiovascular disease or atherosclerosis risk factor. Within the “PAD-aware” cohort, knowledge was poor. Half of these individuals were not aware that diabetes and smoking increase the risk for PAD; 1 in 4 knew that PAD is associated with increased risk of heart attack and stroke; and only 14% were aware that PAD could lead to amputation. All knowledge domains were lower in individuals with lower income and education levels.

Conclusions—The public is poorly informed about PAD, with major knowledge gaps regarding the definition of PAD, risk factors that lead to PAD, and associated limb symptoms and amputation risk. The public is not aware that PAD imposes a high short-term risk of heart attack, stroke, and death. For the national cardiovascular disease burden to be reduced, public PAD knowledge could be improved by national PAD public education programs designed to reduce critical knowledge gaps. (*Circulation*. 2007;116:2086-2094.)

Key Words: claudication ■ myocardial infarction ■ peripheral vascular disease ■ prevention
■ risk factors

Lower-extremity peripheral arterial disease (PAD) is common, affecting up to 12% to 29% of the elderly¹ and as many as 8 million Americans and $\approx 800\,000$ Canadians.^{2,3} Intermittent claudication, the most frequent symptom of PAD, impairs quality of life and functional status.^{4,5} Individuals with PAD suffer a 5-fold-increased relative risk of a heart attack and 2- to 3-fold-greater risk of stroke and total mortality than those without PAD.⁶ Individuals with PAD suffer combined annual rates of heart attack, stroke, and

hospitalization that are comparable to or greater than rates observed in individuals with established coronary artery disease or stroke.^{7,8} PAD has been recognized as a coronary heart disease risk equivalent in national cardiovascular disease (CVD) treatment guidelines.^{5,9,10} The prevalence of PAD is expected to increase as the population ages.^{2,11}

Yet, although the high prevalence and ischemic risk of PAD contribute to high rates of CVD morbidity and mortality, current data suggest that PAD detection and treatment are

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The online Data Supplement, which contains an appendix and a figure, can be found with this article at <http://circ.ahajournals.org/cgi/content/full/CIRCULATIONAHA.107.725101/DC1>.

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Circulation is available at <http://circ.ahajournals.org>

DOI: 10.1161/CIRCULATIONAHA.107.725101

lower than for other forms of atherosclerotic arterial disease.^{12–15} A minority of individuals with PAD are aware of their diagnosis, which contributes to adverse health outcomes. Prior public education efforts linking exposure to atherosclerosis risk factors as a cause of PAD have been limited; thus, general public awareness of PAD risk is assumed to be low. Within this context, a national effort has been initiated to offer the public improved access to PAD-related health information¹⁶ as a key component in support of the congressionally mandated Healthy People 2010 initiative (www.healthypeople.gov). A 2-day PAD Public Education Strategy Meeting was held in 2003 by the not-for-profit Vascular Disease Foundation to provide a national focus on this challenge and to devise an appropriate, science-based educational response.¹⁷ The national Peripheral Arterial Disease Coalition, coordinated by the Vascular Disease Foundation, is an alliance of >50 cardiovascular and vascular health professional societies, health advocacy groups, and government agencies united to provide accurate health information to those with or at risk for PAD (Appendix A of the online Data Supplement and www.padcoalition.org). In a strategic partnership with the National Heart, Lung, and Blood Institute (NHLBI), a national PAD awareness campaign, Stay in Circulation: Take Steps to Learn About PAD, has been initiated.

Public health education programs should provide accurate information that fills known knowledge gaps. However, to measure knowledge change, a population-based baseline must be established. Thus, the purpose of this study was to assess contemporary rates of PAD awareness, defined by specific knowledge of the risk of getting PAD or risks of having PAD, among adults >50 years of age. Furthermore, we hypothesized that this knowledge base would be dependent on gender, age, educational status, and annual income, as has been true for other CVDs. It is anticipated that such data will be useful in informing public educational efforts. The identification of specific knowledge gaps should inform educational campaigns designed to improve public PAD knowledge and thereby diminish the CVD burden in the decades ahead.

Methods

Sample and Survey Design

The survey domains and instrument for this study were created by an independent, interdisciplinary academic committee from the PAD Coalition, including expertise in survey methodology. Data were collected as a telephone, list-assisted random-digit dial survey with 3 different samples.¹⁸ The first was a US national probability sample of adults ≥ 50 years of age conducted between May 30, 2006, and July 20, 2006, resulting in 2251 completed interviews, a 53% response rate (proportion of completed interviews to the total number of eligible respondents by phone number), and a 73% cooperation rate (proportion of completed interviews to the number of contacted eligible respondents). Second, a minority oversample of 250 blacks and Hispanics ≥ 50 years of age living in the United States was conducted between June 27, 2006, and July 17, 2006 (47% response rate; 51% cooperation rate). Blacks and Hispanics were included as an oversample because they are the 2 largest minority groups in the United States and, compared with other minority groups, are less likely to respond to surveys conducted by telephone. In addition, the differential prevalence of PAD in these populations has been the focus of recent investigation.^{2,3} Interviews for the US national and

black/Hispanic respondents were conducted in English or Spanish. Finally, 501 interviews were completed with adults ≥ 50 year of age living in Canada. The data from the Canadian sample are not included here and will be reported separately.

The US national probability sample was weighted by age (coded into four 10-year categories: 50 to 59, 60 to 69, 70 to 79, and ≥ 80 years of age) and on gender to reflect US census estimates for 2006. Disease prevalence responses from the survey were compared with the 2004 National Health Interview Survey to ensure that equivalent populations were assessed.¹⁹ This was performed to ensure that knowledge domains could be compared with this important national data set.

Instrument Pretest and Revision

Before the main survey was fielded, a cognitive pretest was conducted with 25 respondents between May 3, 2006, and May 4, 2006, to better understand how respondents interpreted the questions and whether any questions should be revised because of ambiguous wording. The pretest resulted in only minor edits to the survey instrument.

Statistical Analysis

Data are reported as percentages. With a sample size of 2501, the margin of error is calculated to be <3% for the entire survey. Differences in responses between each ethnic and age group and between surveys were analyzed to assess pair-wise significance as calculated with Pearson's χ^2 test. An ordinary least-squares regression analysis was performed to find the best predictors of PAD awareness among the public. The independent factors in the model included various demographic measures (eg, age, education, income, gender, and race), level of awareness of various diseases, presence of risk factors or CVD, and 5 leg symptoms. For this descriptive survey, corrections for multiple comparisons were not performed. Statistical significance was set at the 0.05 level.

The authors had full access to and take full responsibility for the integrity of the data. All authors have read and agree to the manuscript as written.

Results

Demographic Characteristics of the Survey Population

The final population included 2501 individuals with a mean age of 67.2 ± 12.6 years (Table 1). This sample included 36% in the 50- to 59-year age range, as well as 13% of subjects who were >80 years of age. The survey population was 54% female and predominantly white (75%), and the distribution included 13.8% black and 6.4% Hispanic respondents. Hispanics are underrepresented in the sample compared with the prevalence of this group in the US population. More than half (53.5%) of these subjects had completed some college, and most (59.8%) had an annual household income of <\$55,000.

Risk Factors and CVDs

The survey sample was representative of the US population in its prevalence of common atherosclerosis risk factors and CVDs (Table 2). Of the respondents, 53% reported a history of high blood pressure, 48% had high blood cholesterol, 18% had diabetes, 16% were current smokers, and an additional 33% were former smokers. The survey assessed whether respondents had current CVD symptoms, had a history of cardiovascular ischemic events, or were being treated for such conditions. Coronary ischemic symptoms were common; 19% reported chest pain or angina, 8.6% had a prior heart attack, and 9.8% reported prior coronary angioplasty or coronary artery bypass surgery. Fewer subjects reported prior

Table 1. Demographic Characteristics of the US PAD Awareness Sample

Characteristic	US Sample, n (%)
Total sample	2501 (100)
Gender	
Male	1163 (46.5)
Female	1338 (53.5)
Age, y	
50–59	906 (36.2)
60–69	680 (27.2)
70–79	586 (23.4)
≥80	329 (13.2)
Race/ethnicity	
White	1872 (74.9)
Black	346 (13.8)
Hispanic	161 (6.4)
Other	86 (3.4)
Education	
≤High school	1137 (45.5)
>High school	1,338 (53.5)
Income, \$	
<55 000	1495 (59.8)
≥55 000	638 (25.5)

Distributions in some groups do not add up to 100% because of missing data.

transient ischemic attack symptoms (7.0%), stroke (5.5%), or a carotid revascularization procedure (3.6%). PAD was self-reported by only 1% (n=25) of the population.

Leg Symptoms and Signs

It was hypothesized that PAD knowledge might be greatest in those individuals who had current leg symptoms. The survey

was designed to categorize these leg symptoms by their presence at rest or with ambulation. Respondents frequently reported leg pain with ambulation (eg, 16.4% of respondents reported frequent pain in their legs with walking), and overall, almost 1 in 4 individuals reported some form of leg pain. Leg symptoms were consistently more common in women (28.8% versus 22.6%, women versus men; $P<0.05$), individuals who were >70 years of age (29.1% versus 24.1%, >70 versus <70 years of age; $P<0.05$), nonwhite (34.6% versus 29.5% versus 23.7% for Hispanic versus black versus white respondents; all $P<0.05$), and those who had less than a high school education (34.6% versus 18.5%; $P<0.05$) or a lower annual income (32.0% versus 11.9%; $P<0.05$). Few respondents reported a nonhealing foot wound or sore (1.3%), although this was more common in younger individuals and those with a lower annual income.

Knowledge of Risk Factors, CVDs, and Other Illnesses

The population demonstrated a high awareness (defined as the combination of “somewhat” or “very” familiar responses) of atherosclerosis risk factors, including high blood pressure (89.7%), high blood cholesterol (84.8%), and diabetes (77%) (Table 3). Similarly, this population reported a relatively high awareness of both stroke (73.9%) and coronary artery disease (67.1%). Because there is not yet a common term in widespread use by physicians or the public to describe lower-extremity arterial occlusive disease, PAD awareness was recognized as any positive response to either peripheral arterial disease (or PAD) or peripheral vascular disease. In contrast to high public awareness of atherosclerosis risk factors and other forms of CVD, only 25% of the population reported an awareness of PAD. Public familiarity of PAD was lower than that of either multiple sclerosis or Lou Gehrig’s

Table 2. Risk Factors, Smoking History, and Associated CVDs by Demographic Characteristic of the Study Population

	Gender		Age, y		Race			Education		Income, \$		PAD Symptoms		
	Male	Female	50–69	≥70	White	Black	Hispanic	≤High School	>High School	<55 000	≥55 000	≥1	0	Total
Risk factors														
High blood pressure	53.0	52.3	47.4	61.6	49.8	69.1	50.9	57.3	48.5	56.5	42.6	65.0	48.3	52.6
High cholesterol	48.5	47.5	46.2	51.0	48.2	45.4	50.3	50.4	45.8	50.2	42.2	61.1	43.3	48.0
Diabetes	18.9	18.2	17.7	19.9	15.3	28.3	27.3	23.0	14.6	21.8	11.1	27.9	15.0	18.5
Smoking history														
Current	17.2	14.6	20.4	8.0	14.9	19.4	14.9	20.2	12.3	19.5	9.1	20.1	14.4	15.8
Past	41.2	26.5	30.8	37.7	34.7	29.8	27.3	32.7	34.0	33.4	32.6	34.3	33.2	33.3
Never	41.4	58.7	48.6	54.2	50.4	50.3	57.8	47.0	53.5	47.1	58.3	45.7	52.3	50.7
CVDs														
Chest pain or angina	22.7	16.0	15.8	24.9	18.9	18.5	16.1	21.6	17.0	21.6	13.0	35.6	13.2	19.1
Heart attack	12.3	5.3	5.8	13.3	8.5	6.1	9.3	9.8	7.3	9.8	5.0	15.3	6.1	8.6
Coronary bypass surgery or angioplasty	15.0	5.2	6.8	14.9	10.6	4.3	8.7	10.4	9.2	11.2	7.4	15.6	7.7	9.8
Stroke	5.2	5.8	3.7	8.7	5.0	7.5	3.7	6.3	4.6	7.0	1.9	10.3	3.9	5.5
Ministroke or TIA	7.2	6.8	5.0	10.4	6.8	7.2	5.6	7.5	6.4	8.9	3.0	11.7	5.4	7.0
Carotid artery surgery or stenting	4.1	3.2	2.1	6.3	3.7	3.2	1.9	4.7	2.6	4.3	2.0	8.0	2.1	3.6
PAD	1.2	0.8	0.9	1.2	1.0	0.6	1.2	0.7	1.3	1.2	0.5	0.3	3.1	1.0

TIA indicates transient ischemic attack. Values in bold denote pairwise significance from the associated value.

Table 3. Awareness of Atherosclerosis Risk Factors, CVD, and Other Diseases by Demographic Characteristics (Combining “Very Familiar” and “Somewhat Familiar”)

	Gender		Age, y		Race			Education		Income, \$		Total
	Male	Female	50–69	≥70	White	Black	Hispanic	≤High School	>High School	<55 000	≥55 000	
Risk factors												
High blood pressure	90.0	89.4	91.4	86.7	91.3	89.3	72.0	84.0	94.7	87.2	95.9	89.7
High cholesterol	85.0	84.8	87.5	80.2	87.3	78.0	75.2	77.3	91.5	81.3	94.8	84.8
Diabetes	75.8	78.1	82.6	67.3	78.5	74.3	68.9	69.3	83.9	73.8	87.3	77.0
CVDs												
Stroke	73.2	74.4	79.5	64.0	77.1	63.6	60.2	62.0	84.4	69.5	87.3	73.9
Coronary artery disease	68.8	65.5	72.1	58.3	71.1	54.6	49.1	53.9	78.6	61.3	83.5	67.1
Congestive heart failure	67.2	67.5	71.2	60.5	71.4	55.5	49.1	58.3	75.5	62.5	81.2	67.3
PAD	23.0	28.3	27.6	22.6	27.1	25.7	13.0	16.6	33.9	23.1	32.0	25.8
Other diseases												
Multiple sclerosis	39.7	44.0	48.0	31.7	44.1	37.0	31.7	29.8	52.9	37.3	56.7	42.0
ALS	36.6	36.0	40.7	28.6	39.9	24.6	24.8	23.6	47.7	31.4	51.1	36.3
Cystic fibrosis	27.0	30.9	34.7	19.3	30.7	24.6	20.5	18.9	38.2	24.7	42.5	29.1

Values in bold denote pairwise significance from the associated value.

disease (amyotrophic lateral sclerosis [ALS]) (Table 3 and the Data Supplement Figure). Public familiarity with risk factors and established non-PAD CVD was higher among younger, white, more educated, and higher-income subjects. In contrast, public awareness of PAD was low in all respondents but tended to be lowest among those who were older, male, and nonwhite and had a lower education or income level.

Perceived Causes of PAD

Among those 1331 respondents who expressed any familiarity with PAD (the “PAD aware” cohort), all were asked to describe potential causes of PAD (Table 4). Knowledge of the known risk factors that lead to PAD was limited. Large proportions of the “PAD-aware” adults in this survey were unaware that cigarette smoking (44%) and diabetes (50%) were important causes of PAD. More than half of the

respondents in this population were not aware that high blood cholesterol and high blood pressure serve as PAD risk factors. In contrast, obesity and lack of exercise, for which causal risk of PAD is not directly established, were identified as factors that lead to PAD and were cited to be equally as causal as the known risk factors of diabetes and smoking. These knowledge gaps were significantly more prominent in older, non-white, less educated, and lower-income individuals.

Perceived Consequences of PAD

Public knowledge of the cardiovascular ischemic risk of PAD also was limited. All respondents who expressed familiarity with PAD were asked to describe potential consequences of PAD if untreated (Table 5). Only 25% associated PAD with a risk of heart attack; only 28% associated PAD with a risk of stroke; only 14% associated PAD with a risk of amputation; and only 14% associated PAD with a risk of death. Of note,

Table 4. Perceived Causes of PAD Among Those Aware of PAD by Demographic Characteristics (Combining “A Lot” and “A Moderate Amount” in Response to the Question, “Do the Following Increase the Risk of Getting PAD/PVD?”)

	Gender		Age, y		Race			Education		Income, \$		PAD		Total
	Male	Female	50–69	≥70	White	Black	Hispanic	≤High School	>High School	<55 000	≥55 000	Diagnosed	Undiagnosed	
Being overweight	57.9	54.9	58.3	52.0	58.6	49.7	44.8	42.6	65.7	53.4	67.3	60.0	56.2	56.2
Cigarette smoking	54.0	56.8	59.0	48.9	58.7	46.3	39.7	42.6	64.7	51.0	68.4	72.0	55.3	55.6
Lack of exercise	53.9	52.4	56.3	46.6	55.4	45.2	43.1	39.2	62.7	49.3	64.9	60.0	52.9	53.0
Diabetes	50.9	49.3	54.4	41.3	52.6	42.9	34.5	36.8	59.2	46.2	62.2	52.0	49.8	50.0
High blood pressure	46.7	47.6	50.4	40.8	49.6	41.8	37.9	34.1	56.4	43.5	59.2	72.0	46.6	47.2
High cholesterol	46.7	47.2	50.5	39.9	50.3	37.3	31.0	32.6	57.0	42.5	59.7	80.0	46.3	47.0
Heart attack or stroke	41.6	44.2	47.6	34.1	44.4	40.1	34.5	31.7	51.1	41.1	51.4	72.0	42.5	43.1
Having a close family member who has had a heart attack or stroke	37.0	37.8	40.5	31.6	40.5	26.0	29.3	27.0	44.8	34.9	46.2	48.0	37.3	37.5
Drinking alcohol	30.2	30.7	31.0	29.6	31.0	31.6	24.1	24.4	34.9	30.7	32.2	16.0	30.8	30.5

Values in bold denote pairwise significance from the associated value.

Table 5. Perceived Consequences of PAD Among Those Aware of PAD by Demographic Characteristics in Response to the Question, "Based on What You Know or Have Heard, What Can PAD Lead to if Not Treated?"

	Gender		Age, y		Race			Education		Income, \$		PAD Symptoms		Total
	Male	Female	50–69	≥70	White	Black	Hispanic	≤High School	>High School	<55 000	≥55 000	≥1	0	
Stroke	26.1	28.6	32.5	17.7	26.9	36.2	20.7	18.6	33.8	24.3	35.7	20.5	30.5	27.6
Heart attack	22.6	27.3	29.0	17.9	24.5	31.1	24.1	20.5	28.8	25.2	27.0	24.5	25.8	25.3
Death	14.4	14.3	16.2	10.8	14.4	12.4	13.8	11.3	16.6	13.9	17.0	15.4	13.8	14.4
Amputation	14.6	12.9	15.4	10.1	15.2	6.2	12.1	5.8	19.0	10.8	20.8	12.0	14.3	13.6
Other	6.3	7.1	6.8	6.7	7.0	5.1	8.6	3.0	9.4	5.4	9.5	3.5	8.0	6.8
Disability/inability to walk	6.0	6.4	5.8	7.2	6.6	4.5	5.2	4.5	7.5	5.6	7.6	7.2	5.9	6.2
Blood clot	2.8	5.3	5.0	2.7	4.4	2.3	5.2	2.6	5.3	4.4	4.6	3.2	4.6	4.2

Values in bold denote pairwise significance from the associated value. In this question, individuals were defined as having "PAD symptoms" if they experienced leg pain with exertion.

only 6% described PAD as conferring a risk of limb disability or inability to walk. Knowledge of the cardiovascular and limb ischemic consequences of PAD was greatest in respondents who were younger with more than a high school education and higher income and was not significantly improved when PAD symptoms were present.

Sources of Information About PAD

Survey respondents who stated that they were familiar with PAD were asked their sources of information. The primary PAD information sources were broadcast or cable television (26%), a family member or friend (17%), or magazine (15%). Fewer PAD-aware individuals obtained this information from a physician (14%), nurse (2%), pharmacist (0.2%), or other health professional (2.6%). In addition, few individuals reported obtaining PAD health information from the newspaper (5%), the Internet (3%), or radio (0.7%). Thus, sources of PAD health information were scarce and generally not derived from health professional sources.

Familiarity With and Access to the Ankle Brachial Index

Respondents were asked, "Has a doctor ever used a blood pressure cuff above your ankles to check the blood pressure in your ankles?" Of 1849 responses to this question, only 18.1% of adults had undergone such testing. The accuracy of this reporting is unknown because no external validation was attempted.

Predictors of PAD Awareness

To determine factors that might contribute to public awareness of PAD, we performed a series of univariate analyses of demographic, risk factor, leg pain, and disease awareness variables, followed by a sequential multivariate analysis (Table 6). The multivariate model of predictors of awareness of PAD used questions based on (1) subject familiarity with other CVD (eg, "How familiar are you with the following conditions. . .?"), (2) subject exposure to atherosclerosis risk factors (eg, "Do you have high blood pressure or are you

Table 6. Independent Factors Associated With Increased PAD Awareness: A Multivariate Regression Analysis

Predictor of PAD Awareness	β	τ	<i>P</i>
Awareness factor	...	8.393	0.000
Education (some college or above)	0.097	3.291	0.001
Awareness of cystic fibrosis	0.125	3.067	0.002
Awareness of multiple sclerosis	0.123	2.762	0.006
Awareness of ALS	0.114	2.732	0.006
Awareness of stroke	0.096	2.702	0.007
Awareness of coronary artery disease	0.091	2.627	0.009
Female gender	0.065	2.292	0.022
History of high blood pressure	0.060	2.072	0.039
History of coronary bypass surgery or angioplasty	0.060	2.020	0.044
<i>R</i> = 0.476			
		<i>R</i> ² = 0.227	Adjusted <i>R</i> ² = 0.220
SE = 0.83676			

Population knowledge characteristics that did not predict PAD awareness included age; income; race/ethnicity; history of smoking, high cholesterol, or diabetes; or history of heart attack, carotid surgery, or any leg pain symptom.

treated for high blood pressure?”), (3) presence of leg pain symptoms in the subject (eg, “Do you currently have persistent or recurring pain in your legs when you walk?”), and (4) subject knowledge of a CVD or other disease condition (eg, “How familiar are you with the following conditions. . .?”). This analysis demonstrated that the most powerful contributors to PAD awareness were awareness of other non-CVDs (eg, multiple sclerosis, cystic fibrosis, and ALS), higher education level, awareness of stroke and coronary artery disease, female gender, and a history of high blood pressure, coronary artery bypass surgery, or angioplasty. No other demographic variable, risk factor, or leg pain symptom contributed independently to PAD awareness.

Discussion

Main Findings of This Survey

These data represent the first population-based survey of current public knowledge of PAD and offer key insights that more precisely define a major public knowledge gap regarding this common atherosclerotic syndrome. These knowledge gaps likely impair the opportunity to link disease awareness to improved risk factor control and prevention of cardiovascular ischemic events. Low public awareness of PAD has been demonstrated in smaller surveys,^{14,19a} and these data extend such preliminary observations to a representative national database and permit important subgroup analyses.

In particular, these data demonstrate that the public is largely unaware of PAD as a unique disease compared with other CVDs or risk factors. The public is unaware that PAD is associated with leg symptoms and amputation. Both the general population and those with PAD are not aware that PAD is a powerful risk marker for heart attack, stroke, and death. The inclusion within this survey of measures of awareness of specific risk factors (eg, diabetes mellitus, hypertension, and hypercholesterolemia) and diseases (eg, multiple sclerosis, ALS, and cystic fibrosis) that have been the focus of nationally coordinated educational programs provides relative comparators for what might be achieved through a national PAD effort.

Sources of Knowledge About PAD

Those respondents who were familiar with PAD received knowledge of this condition from television, a friend or family member, and magazines. These data are striking in that they demonstrate that only a relatively small fraction of individuals received information on PAD from a physician (14%), nurse (2%), or pharmacist (0.2%). The impact of Web-based information sources was quite limited (3%) despite current interest in Internet-based educational outreach. These results demonstrate that physicians and other health professionals, although usually seen as arbiters of accurate health information, have not hitherto been well positioned to provide PAD educational resources to the public. This new knowledge base, which defines current sources of public PAD health information, provides an opportunity to use each potential source (eg, health provider, television, and print media) in future PAD awareness campaigns. The potential impact of each source of PAD information could be evaluated prospectively and compared with the current knowledge base.

Ethnicity, Socioeconomic Status, Gender, and Health Disparities

Recent data demonstrate that PAD prevalence is increased in blacks compared with other ethnic groups in the United States.^{2,3} PAD also is known to increase dramatically with age. Thus, the current data that demonstrate a lower awareness of PAD among nonwhite and elderly respondents show that the knowledge gap is greatest in those populations at highest risk of PAD-associated morbidity and mortality. The impact of educational status and annual income on PAD risk has not yet been defined from relevant clinical studies. However, the prevalence of ischemic heart disease and stroke is known to be inversely related to education, income, and poverty status.²⁰ We presume that PAD prevalence is likely to be similarly increased in less educated and poor individuals in whom risk factor profiles are usually adverse. If true, this would define another high risk–low awareness PAD cohort. Finally, our data demonstrate that women had greater knowledge of PAD than men.

Established PAD Diagnoses Are Not Linked to Knowledge of Risk

Major national and international efforts have been invested in evaluating diagnostic methods to establish the diagnosis of CVDs, including PAD.^{5,21,22} However, establishing a diagnosis is not reliably linked to disease awareness or treatment in those affected by CVD. This national public PAD awareness survey demonstrates that individuals with an established PAD diagnosis are not very aware of the causative role of diabetes (52%). Individuals with PAD or PAD symptoms did not demonstrate increased knowledge of the contributing role of other major risk factors (eg, diabetes or hypertension) compared with those without a PAD diagnosis. Similarly, individuals with PAD symptoms were not aware of the associated risk of heart attack and stroke, amputation, or death. The ability of these individuals, working in concert with their primary clinicians, to diminish risk depends on achievement of a relevant frame of risk knowledge. Public knowledge of causes of disease and the benefit of proven treatments is known to be divergent from scientific knowledge.²³

Predictors of PAD Awareness

Whereas it might be anticipated that increased PAD awareness would be observed in elderly individuals or those with known PAD risk factors (eg, diabetes, smoking, or high cholesterol), leg pain symptoms, or a history of heart attack or carotid surgery, none of these factors were observed by multivariate analysis. In contrast, individuals who were generally aware of unusual, high-profile diseases (eg, multiple sclerosis, ALS, or cystic fibrosis) also were most aware of PAD. These data imply that past educational efforts that might reasonably target high-risk cohorts for PAD have not been effective.

Access to the PAD Diagnosis

Leg symptoms, age, and risk factor profiles have been deemed useful in identifying an at-risk population in whom PAD is prevalent and for whom an ankle brachial index (ABI) test is indicated.⁵ On the basis of the estimated PAD preva-

lence in an age-matched population, at least 5% to 7% of our sample would be anticipated to have an abnormal ABI (regardless of leg symptoms) and thus a PAD diagnosis and PAD-associated risk. This survey demonstrates that individuals at risk often do not undergo PAD diagnostic testing. Approximately 16% of our population reported exertional leg pain; nearly 1 in 4 respondents reported other leg pain symptoms; and report of other atherosclerosis risk factors was common. Nevertheless, only 2% of subjects reported an established PAD diagnosis, and only 18% reported ever having undergone an ABI test (defined as a blood pressure test at the ankle level with a blood pressure cuff). Thus, use of the ABI and/or communication of its utility to at-risk populations remain very low.

Knowledge and Risk of CVD: Lessons From Other Public CVD Awareness Campaigns

CVD knowledge and awareness has served as a focus of investigation for >3 decades.^{24,25} Evaluations of US and Canadian hypertension awareness have demonstrated that diminished knowledge of hypertension risk is linked to low rates of blood pressure control.²⁶ When such baseline rates are linked to programs of public education, hypertension treatment and control can improve.²⁷ Public cardiovascular knowledge surveys have demonstrated that performance of a risk assessment test (eg, blood pressure measurement) may not be consistently remembered by patients or linked to knowledge of effective treatment.²⁸ Such data demonstrate that use of cardiovascular testing strategies may or may not be linked to relevant clinical outcomes, depending on whether useful knowledge is transferred to the patient after such tests are performed.

PAD is a CVD with documented ethnicity-based risk, and the current data demonstrate an ethnicity-related knowledge gap. We note that such ethnic differences in specific dimensions of knowledge and beliefs about other CVDs such as hypertension have been documented and likely account for disparities in hypertension control.^{29,30} When public educational efforts were sustained, ethnic health disparities for hypertension were significantly improved.³¹ If specific ethnicity-based knowledge gaps are confirmed for individuals with PAD, then culturally appropriate educational programs that address PAD-specific knowledge deficiencies could reduce such disparities.

Gender is known to affect awareness of other CVDs such as heart attack and stroke.³² Stroke awareness is suboptimal in women and is lowest in racial and ethnic minority women who are known to be at highest risk.³³ Our data demonstrate that <1 in 7 women is aware that PAD can lead to heart attack or death. Public educational efforts to improve recognition of cardiovascular risk (specifically for heart attack and stroke) in women have demonstrated temporal improvement.³² Such efforts have not hitherto included efforts to improve PAD awareness. We also note that our data demonstrate that men currently have a lower knowledge base than women, as has been shown for minority populations with hypertension.³⁴ Thus, future PAD public educational efforts should provide benefit to both genders, which remain at nearly equal relative risk of PAD-associated ischemic events.

The National PAD Stay in Circulation: "Take Steps to Learn About PAD" Campaign

National public awareness campaigns have successfully contributed to the prevention, early detection, and treatment of many CVDs. These campaigns have been created by the synergy that can be achieved by the strategic partnership of public sector advocacy (eg, not-for-profit foundations) and governmental program support. A number of successful national public educational programs have been developed to diminish both risk factors and manifestations of CVD, in recognition that cardiovascular illnesses are the leading cause of death in the United States. PAD is 1 of the 3 major clinical atherosclerotic syndromes, and all share common pathogenic risk factors such as diabetes, tobacco smoking, hypertension, and hypercholesterolemia. As such, despite low current rates of public awareness of PAD, these data provide an objective platform from which this knowledge base may be improved.

The NHLBI has launched the Stay in Circulation national PAD public awareness campaign (www.aboutpad.org) in a strategic partnership with the PAD Coalition (www.padcoalition.org) to raise awareness about PAD and its associated risks. The data from the current survey can be used to inform future campaign strategic approaches. For example, this survey, in association with other PAD epidemiology data, will provide tools to permit culturally appropriate messages and PAD awareness tools to be offered to diverse populations. Such messages and tools must be designed with knowledge that social variables, language, culture, and assimilation may promote or impede PAD awareness improvement. These data also will serve as a baseline for assessing future changes in awareness of and knowledge about PAD.

Clinical Implications

Surveys of general practitioners and vascular specialists have indicated that patients with peripheral arterial atherosclerosis, compared with patients with coronary atherosclerosis, are much less likely to be treated by their physicians to lower rates of heart attack, stroke, and death.^{12,13} Because achieving target risk reduction goals is known to be improved with active patient participation, it is probable that efforts to improve public awareness of PAD could be used to achieve major improvements in cardiovascular outcomes.³⁵ For example, if more at-risk individuals are aware of PAD, they will be in a better position to initiate a discussion with their primary clinician about this risk. Knowledge gaps can be diminished by providing Stay in Circulation campaign products (eg, PAD fact sheets) to both the public and clinicians. When awareness gaps are improved by access to knowledge, an informed patient is best positioned to diminish risk in collaboration with an informed clinical provider.

Study Limitations

This survey provides the best current estimates of public PAD knowledge and awareness among the public. However, as for all large national surveys, it is not possible to achieve a complete response rate; thus, sampling error likely overestimates public PAD knowledge. We attempted pre hoc to achieve an adequate sample size to achieve a 3% margin of error for these survey results comparable to most national

health surveys. We also note that assessment of public awareness of PAD may be associated with other ascertainment errors. Until recently, there have been no prior efforts to establish a common PAD nomenclature for clinicians or the public. Before the 2006 publication of the guidelines for managing PAD,⁵ differing terminology was used to describe PAD to the public, which could diminish efforts to improve public PAD awareness. As with any telephone survey, we are not able to verify the accuracy of self-reported medical conditions or leg symptoms. We also note that survey assessments to measure the use of the ABI test are confounded by subject misunderstanding of the meaning of the ABI test. The ABI test may have been performed without the patient being aware of the test name, significance of the result, or associated health implications. Conversely, the 18% figure for ABI assessment in this study may have been underestimated or overestimated in this survey.

Conclusions

This survey demonstrates that the public is not well informed about PAD, with major knowledge gaps demonstrated regarding the definition of PAD, who is at risk, and the causes of PAD. The public does not know that PAD predicts future heart attack, stroke, amputation, and death. Knowledge gaps are most prominent among those individuals who are at the highest risk of having PAD (eg, individuals who are older, are a minority, or have lower attained educational or income levels). The absence of this knowledge likely contributes to the known underrecognition of PAD symptoms by the public and known delay in achieving a diagnosis of PAD. The absence of knowledge about the specific impact of PAD on leg symptoms, functional status, and amputation is likely to contribute to low use of PAD risk-reduction and symptom-improving therapies. These data can be used to inform the educational efforts of national, regional, and practice-based PAD public education programs.

Acknowledgments

We acknowledge the contributions of Drs David Robinson, Claude Lenfant, Barbara Alving, Elizabeth G. Nabel, and Gregory J. Morosco; Susan T. Shero; and the staff of the NHLBI, without whose support this effort would not have been initiated.

Sources of Funding

Unrestricted educational grants to the Peripheral Arterial Disease Coalition to support the independent design and performance of this survey were provided by both the Bristol-Myers Squibb/Sanofi-Aventis Partnership and Cordis Endovascular.

Disclosures

Dr Hirsch has received research grant support from the National Institutes of Health, the Bristol-Myers Squibb/Sanofi-Aventis Partnership, Sanofi Aventis, Omron, and AstraZeneca. Dr Murphy has received research support from the National Institutes of Health, Boston Scientific, Cordis, Guidant, Otsuka America Pharmaceuticals, and Pfizer. Dr Treat-Jacobson serves on a speakers bureau for the Bristol-Myers Squibb/Sanofi-Aventis Partnership. Dr Mohler has received research grant support from the Bristol-Myers Squibb/Sanofi-Aventis Partnership and GlaxoSmithKline and serves on speakers' bureaus for AstraZeneca, Bristol-Myers Squibb/Sanofi-Aventis Partnership, and Merck. Dr Creager has received research grant support from ActivBiotics, Genzyme, and Sanofi-Aventis, and Sigma Tau and serves on a speakers' bureau for the Bristol-Myers

Squibb/Sanofi-Aventis Partnership. Dr Hobson receives research grant support from the National Institutes of Health and honoraria from Gore, Medtronic, and Abbott Vascular. Dr Robertson serves on an advisory board for Merck. M.B. Lovell, G. Twillman, P. Schroeder, and Drs Criqui, Harwood, and Howard report no conflicts.

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