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Disparities in Diagnosis, Treatment, and Outcomes of Peripheral Artery Disease

JACC Scientific Statement

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ABSTRACT

Disparities by sex, race, socioeconomic status, and geography exist in diagnosis, treatment, and outcomes for people with lower extremity peripheral artery disease (PAD). PAD prevalence is similar in men and women, but women have more atypical symptoms and undergo lower extremity revascularization at older ages compared to men. People who are Black have an approximately 2-fold higher prevalence of PAD, compared to people who are White and have more atypical symptoms, greater mobility loss, less optimal medical care, and higher amputation rates. Although fewer data are available for other races, people with PAD who are Hispanic have higher amputation rates than White people. Rates of amputation also vary by geography in the United States, with the highest rates of amputation in the southeastern United States. To improve PAD outcomes, intentional actions to eliminate disparities are necessary, including clinician education, patient education with culturally appropriate messaging, improved access to high-quality health care, science focused on disparity elimination, and health policy changes. (J Am Coll Cardiol 2023;82:2312-2328) © 2023 by the American College of Cardiology Foundation.

Lower extremity peripheral artery disease (PAD) affects approximately 230 million people worldwide and in 2007 was estimated to affect 8.5 million people in the United States.[1,2] Given the growing number of older people in the United States and the increasing number of people with diabetes, the number of people with PAD in 2023 is likely greater than the 8.5 million estimated in 2007. Compared with people without PAD, those with PAD have higher rates of cardiovascular events and major adverse limb events (MALE), greater walking impairment, increased mobility loss, and poorer quality of life.[3-8] In people with PAD, disparities in prevalence, diagnosis, treatment, and outcomes by sex, race, geography, and socioeconomic status are well documented and contribute to adverse outcomes.[2,9-11] This review begins with an overview for PAD epidemiology and treatment guidelines, followed by a summary of current evidence regarding disparities in diagnosis, treatment, and outcomes of PAD by

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HIGHLIGHTS

- Women present for revascularization at older ages, compared to men.
- The prevalence of PAD in Black people is approximately twice that of White people.
- PAD amputations are more common in Black and Hispanic people, than in White people.
- Eliminating disparities in PAD requires interventions that include improvements in education, access to care, and health policy.

sex, race, geography, and socioeconomic status. While acknowledging that important disparities in PAD diagnosis and treatment exist worldwide, in this review we focus on evidence from the United States. Solutions to reduce disparities in PAD are proposed.

OVERVIEW OF PAD EPIDEMIOLOGY

As of 2000, approximately 8.5 million people in the United States were living with PAD, representing about 7.2% of people 40 years and older.[2] Older age is associated exponentially with higher PAD prevalence, and approximately 20% of people 80 years or older have PAD.[2,4] Typical risk factors for cardiovascular disease, such as hypertension and dyslipidemia, are also associated with increased risk for PAD.[4,8] However, cigarette smoking and diabetes are even more strongly linked to PAD than to coronary heart disease or ischemic stroke.[12,13] Less traditional risk factors, such as lipoprotein(a), homocysteine, and inflammatory factors such as high-sensitivity C-reactive protein, are also associated with PAD.[14] Genetic factors also contribute to PAD. Among fraternal and identical twins, approximately 48% of variance in the ankle-brachial index (ABI), the most common diagnostic measure of PAD, was explained by genetic factors.[15] People with PAD commonly have coexistent coronary heart disease and ischemic stroke.[4,8] Chronic kidney disease, especially end-stage kidney disease, is common among patients with PAD.[16]

OVERVIEW OF EPIDEMIOLOGIC DISPARITIES IN PAD

Overall, the prevalence of PAD is similar in men and women.[1-3] However, men have more severe PAD than women, and estimates of differences in prevalence of PAD by sex are biased by the finding that in people with no cardiovascular disease, women have lower ABI values than men.[4,17] In the United States, PAD prevalence is similar in people who are White, Hispanic, or Native American, but Black people have approximately twice the rate of PAD as other racial and ethnic groups.[2] Race differences in traditional and novel risk factors do not fully explain the higher prevalence of PAD among Black people.[4] In a systematic review, people who were Black had more distal lower extremity vessel involvement, even after adjustment for diabetes and other risk factors.[18] Data on the prevalence of PAD in other racial and ethnic groups are limited. One study demonstrated that the prevalence of PAD was similar between Native Americans and White people, and studies of community-dwelling populations in the United States have shown lower rates of PAD in Asian and Hispanic Americans compared with White people[4,14,19,20] However, racial groups are not homogeneous. Compared with people who were Mexican American, Cuban Americans had 3-fold higher odds of PAD.[21]

ABBREVIATIONS AND ACRONYMS

ABI = ankle-brachial index
CMS = Centers for Medicare and Medicaid Services
GLP1 = glucagon-like peptide-1
MALE = major adverse limb event(s)
PAD = peripheral artery disease

OVERVIEW OF GUIDELINE-RECOMMENDED THERAPY FOR PAD

First-line therapies to prevent cardiovascular events and MALE in PAD include smoking cessation, healthy diet, and reducing a sedentary lifestyle.[22] In an exploratory, post hoc analysis from the PREDIMED (Prevención con Dieta Mediterránea) randomized clinical trial, a Mediterranean diet reduced new diagnoses of PAD compared with a control group that received counseling on a low-fat diet.[23] Patients with PAD should follow a heart-healthy Mediterranean diet, consisting of fresh vegetables and grains, fish, olive oil, and low-sodium nuts.

Patients with PAD who continue to smoke have higher rates of cardiovascular events, MALE, and poor outcomes after lower extremity revascularization compared with those who quit smoking.[24] To support people with PAD in smoking cessation, treatments that combine pharmacotherapy, such as varenicline, with counseling support, are recommended.[22,25]

Cholesterol-lowering drugs that reduce cardiovascular event rates in patients with PAD include statins, ezetimibe, monoclonal antibodies to proprotein convertase subtilisin/kexin type 9, and bempedoic acid.[22,25,26] Maximally tolerated doses of potent statins (such as atorvastatin 80 mg or rosuvastatin 40 mg) for all patients with PAD are recommended,[22,25] and some guidelines also recommend

combination drug therapy to attain low-density lipoprotein values <55 mg/dL for patients with PAD.[25] Greater low-density lipoprotein lowering is associated with greater reductions in cardiovascular events, without significant adverse event rates.[5,25]

Patients with PAD who have hypertension should be treated to attain blood pressure <130/80 mm Hg.[22,25] No specific antihypertensive medications have consistently demonstrated better outcomes when prescribed for people with PAD with hypertension. However, in subgroup analyses of the participants with PAD in the HOPE (Heart Outcomes Prevention Evaluation) randomized clinical trial, ramipril significantly reduced rates of MACE compared with placebo.[27]

Although better glycemic control prevents microvascular complications, no definitive evidence has established that more intensive glucose lowering reduces cardiovascular events or MALE in outpatient populations.[22,25] Newer therapies such as sodium-glucose cotransporter-2 inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists reduced rates of cardiovascular events, heart failure, and kidney complications in cohorts that included people with PAD.[28] GLP-1 receptor agonists were associated with fewer PAD-related amputations.[29] Patients with PAD and type 2 diabetes mellitus should be considered for treatment with GLP-1 receptor agonists and sodium-glucose cotransporter-2 inhibitors.[28-30]

Current practice guidelines recommend antiplatelet therapy with aspirin or clopidogrel to reduce cardiovascular events in patients with PAD.[22,25] However, in randomized clinical trials, aspirin prescribed as a single therapy has not significantly and consistently reduced cardiovascular event rates.[31] Among patients with PAD in the CAPRIE (Clopidogrel Versus Aspirin in Patients at Risk of Ischaemic Events) trial, clopidogrel significantly reduced cardiovascular event rates compared with placebo, but these subset results were post hoc.[32] Rivaroxaban 2.5 mg twice daily combined with aspirin 81 mg significantly reduced cardiovascular events, all-cause mortality, and MALE in people with PAD compared with aspirin 81 mg alone.[33]

OVERVIEW OF TREATMENT FOR WALKING IMPAIRMENT IN PEOPLE WITH PAD

Atherosclerotic obstruction of lower extremity arteries inhibits oxygen and energy delivery to lower extremity skeletal muscle during walking activity. People with PAD typically develop lower extremity pain, burning, cramping, or weakness during walking that resolves within 10 minutes of rest.[34] More severe PAD is associated with slower walking velocity and shorter distances on the 6-minute walk test.[35] People with PAD also have faster declines in walking ability over time compared with those without PAD, and more severe PAD is associated with greater decline.[36] Among 260 people with PAD and 110 without PAD who completed a 6-minute walk without resting at baseline, rates of becoming newly unable to walk for 6 minutes without rest at 2-year follow-up were 38.5% in people with ABIs <0.50, 19.2% in those with ABIs of 0.50 to 0.70, 6.2% in those with ABIs of 0.71 to 0.89, and 1.7% in those with ABIs of 0.90 to 1.40.[36]

Supervised exercise is first-line therapy for PAD, has been covered by the Centers for Medicare and Medicaid Services (CMS) since 2017, and typically consists of walking on a treadmill 3 times weekly in the presence of an exercise physiologist or nurse.[22,25] However, few people with PAD participate in supervised exercise programs.[25] Some non-Medicare insurance companies do not cover supervised exercise for patients with PAD. Home-based walking exercise that incorporates behavioral change methods and helps patients adhere to home-based exercise that induces ischemic leg symptoms is also highly effective for PAD and is an appropriate alternative to supervised exercise for patients with PAD.[22,25,37] Cilostazol is the only medication recommended in American Heart Association/American College of Cardiology clinical practice guidelines to improve walking ability among patients with PAD, but it has modest benefits, and up to 40% of patients cannot tolerate cilostazol because of adverse effects including headache, diarrhea, and palpitations.[22,25,38] **Table 1** outlines documented disparities and the potential for disparities in guideline-recommended therapies for PAD.

SEX DIFFERENCES IN THE DIAGNOSIS AND TREATMENT OF PATIENTS WITH PAD

To our knowledge, gender roles and PAD outcomes have not been studied, and outcomes in patients with PAD who are gender diverse or transgender have not been reported. Therefore, in this review we focus on sex (rather than gender) differences in the diagnosis and treatment of PAD. When considering sex differences in the diagnosis and treatment of PAD, biologic factors can be relevant for some comparisons between men and women. For example, in people without PAD, men typically have more muscle mass and are stronger than women.[39] Smaller artery size in women, compared with men, affects the selection of

TABLE 1 Disparities in Guideline-Recommended Treatments for PAD

Treatment	Efficacy Evidence	Disparity Evidence by Sex, Race, or SES	Potential for Disparities Not Yet Documented
Cholesterol-lowering therapy	• Significantly reduces cardiovascular event rates compared with placebo[21,25] • Lower LDL cholesterol is associated with lower cardiovascular event rates[21,25]	• Women were less likely than men to be prescribed cholesterol-lowering therapy and more likely to decline cholesterol-lowering therapy[55-58] • People who are Black were less likely to be prescribed statins and antiplatelet drugs than people who are not Black[78,79]	• Increased costs of newer and more potent cholesterol lowering therapies may reduce their accessibility to specific populations
Smoking cessation	• People who smoke have higher rates of adverse outcomes	• People who were Black and of lower SES have higher rates of cigarette smoking[113,114]	• Poorer SES and poor access to care may reduce assistance with smoking cessation
Diabetes mellitus	• Certain drug therapies, such as SGLT2 inhibitors and GLP1 agonists, have prevented adverse outcomes in patients with cardiovascular disease, such as PAD		• Poor access to healthy foods, such as grocery stores with fruits and vegetables may contribute to PAD-related disparities in people who are Black or who have lower SES
Antiplatelet and antithrombotic treatment	• Antiplatelet therapy such as clopidogrel and rivaroxaban 2.5 mg twice daily plus 81 mg aspirin each reduce cardiovascular event rates in PAD	• People with PAD who are Black were less likely to receive antiplatelet therapy compared with White patients	• Lack of access to health care may result in lower rates of optimal antiplatelet therapy for people with PAD
Supervised walking exercise	• Improved treadmill walking performance compared with control; improves 6-minute walk distance by approximately 25-35 m[25]	• Efficacy is similar between men and women and between people who are Black and not Black[64] • Women were less likely than men to participate in CMS-covered supervised exercise[82] • Black patients were less likely to participate in CMS-covered supervised exercise[66] • People with PAD who were Black and those of lower SES were more likely to report that the $11 copay per exercise session was a barrier to participation[82]	• Lack of availability of supervised exercise facilities in urban and rural areas
Home-based walking exercise	• Improves 6-minute walk distance by approximately 45-55 m compared with control[64,107]	• Efficacy is similar between men and women and between people who are Black and those who are not Black[65,66]	• Structured home-based walking exercise is not widely available in the United States, and evidence regarding disparities in access is not available

CMS = Centers for Medicare and Medicaid Services; GLP-1 = glucagon-like peptide-1; LDL = low-density lipoprotein; PAD = peripheral artery disease; SES = socioeconomic status; SGLT2 = sodium-glucose cotransporter-2.

revascularization procedures.[9,40] Other sex differences, such as in PAD stage at the time of revascularization or intensity of risk factor treatment, may be due to sex bias or gender role differences, but these associations have not been definitively established.

THE PREVALENCE OF PAD IN WOMEN. When the ABI is used to define PAD, the prevalence of PAD is similar between men and women (Table 2).[4,41-43] However, some epidemiologic studies have reported higher prevalences of borderline ABI (ie, 0.90-0.99) and low-normal ABI values (ie, 1.0-1.09) in women compared with men.[7,43] In MESA (Multi-Ethnic Study of Atherosclerosis), among community-dwelling men and women without clinical evidence of cardiovascular disease and without cardiovascular disease risk factors, women had lower mean ABI values than men, suggesting that intrinsic sex differences in ABI values in the absence of atherosclerosis may account for the higher prevalence of borderline ABI values and low-normal ABI values in women compared with men.[17]

SEX DIFFERENCES IN PAD SYMPTOMS. Intermittent claudication, defined as exertional calf pain that does not begin at rest and that resolves within 10 minutes of rest, is the classic manifestation of PAD.[34] However, most people with PAD do not report these classic symptoms, and many are asymptomatic (ie, they report no exertional leg symptoms), often because they have slowed their walking speed or limited physical activity to avoid ischemic leg symptoms.[34,35,44] Other people with PAD report atypical exertional leg symptoms, often related to comorbidities such as spinal stenosis or peripheral neuropathy.[34]

Among people with PAD, women have a higher prevalence of atypical leg symptoms than men.[45-47] In the WALCS (Walking and Leg Circulation Study), among 460 people with PAD identified from Chicago-area noninvasive vascular laboratories (40.6% women), women had a lower prevalence of classic claudication symptoms (28.9% vs 35.2%), were less likely to continue walking after the onset of ischemic

TABLE 2 Disparities in the Prevalence, Symptoms, and Treatment of PAD by Sex and Race

Domain	Sex	Race	Potential Implications
Prevalence	• The prevalence of PAD is similar in men and women[41-43]	• People who are Black have an approximately 2-fold higher prevalence of PAD compared with people who are White • Among women, American Indian race is associated with a higher prevalence of PAD compared with White race[2,4]	• PAD may be overlooked in women if clinicians believe that women are protected from cardiovascular disease • As PAD is underdiagnosed, this problem may disproportionately affect people who are Black and American Indian women
Symptoms	• Women with PAD have a higher prevalence of atypical leg symptoms and asymptomatic PAD[45-47]	• Among people with PAD, those who are Black have a higher prevalence of atypical leg symptoms and asymptomatic PAD compared with those who are White[77]	• A higher prevalence of asymptomatic PAD and PAD with atypical leg symptoms in women and people who are Black may lead to underdiagnosis of PAD in these populations
Smoking cessation		• Smoking prevalence is highest among non-Hispanic American Indian/Alaska Natives (27.1%) followed by other (19.5%), non-Hispanic Blacks (14.4%), non-Hispanic Whites (13.3%), and Asians (8.0%)[113]	• Racial and ethnic groups with higher cigarette smoking rates may be at higher risk for PAD progression
Medications to prevent cardiovascular events	• Among people with PAD, women are less likely to be prescribed statins compared with men and may be less adherent to statins[59-62]	• Among people with PAD, those who are Black are less likely to receive therapy with statins or antiplatelet medications[79-81]	• Undertreatment with medications that prevent cardiovascular events exposes women and people who are Black to higher cardiovascular event rates
Exercise therapy	• Supervised and home-based walking exercise are similarly effective in men and women, but women are less likely to participate in supervised exercise than men with PAD[65-67]	• Supervised and home-based walking exercise are similarly effective in people with PAD who are Black, compared with those who are White; in Chicago, people with PAD who were Black were more likely to be unwilling or unable to pay the $11 copay per supervised exercise session than people who were White[65-67]	• Financial barriers may prevent patients who are Black or Hispanic from engaging in effective exercise treatment
Lower extremity revascularization	• Women undergo lower extremity revascularization at an older age than men and are less likely to be revascularized for claudication symptoms	• People who are Black undergo lower extremity revascularization at a younger age than people who are White; people who are Black are less likely to undergo revascularization before amputation[83-92]	• Variability in PAD care results in inequitable access to high-quality care in some people with PAD

PAD = peripheral artery disease.

leg symptoms (5.9% vs 11.0%), and had a higher prevalence of exertional leg symptoms that also sometimes occurred at rest (27.8% vs 13.2%) (overall $P < 0.001$ for sex differences in leg symptoms).[45] Mean ABI values were 0.64 ± 0.15 in women and 0.66 ± 0.14 in men. Women had a higher prevalence of spinal stenosis than men with PAD (16.6% vs 6.6%; $P < 0.001$), which may have contributed to the higher prevalence of atypical leg symptoms in women.[45] A meta-analysis of 1,929,966 people with PAD from 21 studies showed that women had a lower prevalence of intermittent claudication symptoms and a higher prevalence of atypical leg symptoms than men.[47] A population-based study of 5,080 adults in Sweden that included 914 people with PAD reported a higher prevalence of asymptomatic PAD in women than men (12.6% vs 9.4%; $P = 0.03$).[48] Although the higher prevalence of atypical leg symptoms in women with PAD could contribute to underdiagnosis of PAD in women, to our knowledge, a higher prevalence of underdiagnosed PAD in women compared with men has not been documented.

Explanations for sex differences in leg symptoms in PAD are unknown. As people with PAD restrict walking activity or slow walking speed to avoid ischemic leg symptoms,[35,49] asymptomatic PAD could be more common in women if they have lower physical activity than men. Alternatively, a higher prevalence of knee arthritis, peripheral neuropathy, and spinal stenosis in women with PAD, compared with men with PAD, may cause a higher prevalence of atypical leg symptoms in women.[45] It is also possible that women with PAD experience and report ischemic leg symptoms differently than men.

SEX DIFFERENCES IN FUNCTIONAL IMPAIRMENT, FUNCTIONAL DECLINE, AND QUALITY OF LIFE IN PAD. Women with PAD have poorer walking performance compared with men with PAD, but these differences may be explained by biologic differences in muscle mass, muscle strength, or oxygen uptake between men and women.[45,46,50-52] For example, among older people without mobility impairment, men had greater knee extension strength and larger muscle area than women, and this phenomenon was observed in Black and White participants.[39] Among

healthy older people, women had slower walking velocity and required more time to complete 5 stands from a seated position than men.[53] In 560 people with PAD and intermittent claudication (12.8% women), treadmill distance to onset of intermittent claudication symptoms was 33% shorter and maximal treadmill walking distance was 23% shorter in women than men.[52] Compared with men with PAD, women with PAD have poorer lower extremity strength and smaller calf muscle area.[45,51] In the WALCS cohort of 460 participants with PAD, women had significantly slower walking speed over 4 m and shorter 6-minute walk distance than men (319.1 m vs 360.1 m; $P < 0.01$).[45] After adjusting for sex differences in leg strength, 6-minute walk distance differences were attenuated but remained statistically significant (331.9 m vs 340.5 m; $P = 0.022$).[45] In a longitudinal analysis of 280 patients with PAD from the WALCS cohort with mean follow-up of 47 months, compared with men, women had significantly higher rates of becoming unable to walk for 6 minutes continuously (HR: 2.30; 95% CI: 1.30-4.06; $P = 0.004$), greater declines in walking velocity, and greater declines in 6-minute walk distance.[51] Women were more likely than men to report new mobility loss at follow-up, defined as becoming unable to walk up and down a flight of stairs or walk one-quarter mile without assistance.[51] These differences were attenuated and no longer statistically significant after adjusting for sex differences in calf muscle area.[51] Sex differences in cardiopulmonary fitness or calf muscle hemoglobin oxygen saturation may also contribute to sex differences in functional performance.[50,52]

Evidence regarding sex differences in quality of life in patients with PAD is mixed. In a small study of 33 women and 34 men with PAD identified from a primary care setting, 36-Item Short Form Survey physical functioning score was significantly worse in women (37.5 vs 53.2 [lower scores are worse]), but no other domains differed by sex.[46] In the PORTRAIT (Patient-Centered Outcomes Related to Treatment Practices in Peripheral Arterial Disease: Investigating Trajectories) study, among 1,274 patients with PAD (38% women) identified from the Netherlands, Australia, and the United States, women had significantly poorer scores on the Peripheral Artery Questionnaire domains of quality of life, physical functioning, social functioning, and symptom stability compared with men.[54] The Peripheral Artery Questionnaire is a PAD-specific health status instrument.[54] However, sex differences were not identified in the EQ-5D quality-of-life score or in treatment satisfaction.[54] Evidence regarding sex differences in the prevalence of depression among patients with PAD has been mixed.[54-57] In a systematic review, 6 of 10 studies evaluating the prevalence of depression in patients with PAD reported higher rates of depression in women.[57] These results are not unique to PAD. In people with and without coronary heart disease, it is well established that women have higher rates of depression than men.[58]

SEX DIFFERENCES IN MEDICAL TREATMENT OF PATIENTS WITH PAD. Sex-based differences in treatment have been documented at all stages of PAD severity.[59-63] Women with PAD are less likely to be prescribed statins and less likely to adhere to statin therapy.[59-62] In a U.S. Department of Veterans Affairs administrative pharmacy database that included 195,467 veterans with PAD (1.6% women), statin prescription rates and adherence rates were lower in women compared with men.[59] Among 42,020 patients undergoing lower extremity revascularization in the United States who were not taking statins at the time of revascularization, women were less likely than men to be prescribed statins after lower revascularization.[61] However, women were more likely than men to report that a clinician advised taking a statin.[61] Importantly, rates of statin use are suboptimal in both men and women with PAD.[64]

SEX DIFFERENCES IN EXERCISE THERAPY AND PAD. In randomized clinical trials that included nearly 50% women, no significant differences in response to supervised or home-based walking exercise interventions were identified between men and women.[65,66] Women with PAD were significantly less likely to participate in Medicare-covered supervised exercise than men with PAD, but in a study of 73 people with PAD in the Chicago area (43.8% women) who received referrals for supervised exercise, women were significantly more likely than men to report participating in supervised exercise.[67]

SEX DIFFERENCES IN LOWER EXTREMITY REVASCULARIZATION. Compared with men, women undergoing lower extremity revascularization are typically older by about 3.5 years and more likely to undergo revascularization for chronic limb-threatening ischemia than for intermittent claudication symptoms.[61,68,69] In the National Inpatient Sample of 2,324,872 patients (42% woman) treated between 2000 and 2016, women undergoing lower extremity revascularization were older than men by a mean of 2.6 years, more often presented with limb-threatening ischemia, were more likely to undergo endovascular procedures, and were less likely to have open surgery compared with men.[63] While limb-threatening ischemia is a more common indication for lower extremity revascularization among women

than men, female sex has been associated with lower rates of amputation in the United States, and among patients with chronic limb-threatening ischemia, women are less likely to undergo amputation than men.[61]

Sex differences in procedure type for patients undergoing lower extremity endovascular revascularization between 2010 and 2016 were evaluated among 58,247 patients (41% women) with 106,073 arteries treated in the VQI (Vascular Quality Initiative) registry.[68] For endovascular procedures of the femoral popliteal and tibial arteries, women were significantly less likely to be treated with stenting or atherectomy than men.[68] No sex differences in procedure type were observed for endovascular procedures in the iliac arteries.[9] However, after endovascular procedures, women were more likely than men to undergo reintervention in the femoropopliteal arteries (HR: 1.28; 95% CI: 1.17-1.40) and more likely to develop occlusion in the iliac (HR: 1.42; 95% CI: 1.12-1.81) or femoropopliteal arteries (HR: 1.19; 95% CI: 1.06-1.34).[68]

In an analysis of 64,752 patients (38% women) from the VQI registry of lower extremity revascularization procedures performed between 2010 and 2020, women were significantly more likely than men to undergo reintervention after endovascular, infrainguinal bypass, and suprainguinal bypass revascularizations at 1-year follow-up.[69] Other studies showed no sex differences in patency after lower extremity revascularization.[70,71] Data are mixed regarding associations of sex with mortality after lower extremity revascularization, with some evidence showing no sex differences and others showing either higher or lower mortality rates in women compared with men after revascularization.[72-74] Inconsistency of sex differences in outcomes after lower extremity revascularization may be due to length of follow-up. In a meta-analysis of 40 studies that compared sex differences in adverse events after lower extremity revascularization, women had higher rates of mortality, amputation, early graft thrombosis, embolization, and cardiac, stroke, and pulmonary complications during 30-day follow-up, but after 30-day follow-up, no sex differences in long-term survival, primary or secondary patency of the revascularized limb, or limb salvage were identified.[72]

SEX DIFFERENCES IN ARTERY SIZE AND LOWER EXTREMITY REVASCULARIZATION. Women often have smaller artery diameters and may have reduced arterial compliance compared with men.[9,40] As clinical trials of endovascular devices tend to include higher proportions of men, fewer data exist on how these devices perform in women.[40] In addition, women may be less likely to be offered lower extremity revascularization than men or may be less likely to agree to lower extremity revascularization than men. Future research should study whether characteristics such as caregiving, social isolation, physical activity, income, and access to high-quality health care influence sex and gender differences in lower extremity revascularization procedure rates and outcomes.

RACE, ETHNICITY, AND PAD

RACISM AS A CONTRIBUTOR TO DISPARITIES IN PAD. Race is a social construct and a proxy for racism and inequitable distribution of resources, resulting in adverse health consequences, such as those documented between Black and White people with PAD. The legacy of slavery and structural racism in the United States have contributed to poorer health, lower socioeconomic status, and unequal care in Black compared with White people including among people with PAD.[75] Racial inequities in access to healthy diets, environments amenable to exercise and physical activity, and high-quality health care can contribute to the development and progression of PAD and more adverse outcomes in people with PAD who are Black.[75] Racism also adversely affects people who are Native American, Hispanic, and Asian, preventing the attainment of optimal health.[75] Effective strategies to overcome disparities in PAD diagnosis, treatment, and outcomes must be mindful of the social and political factors contributing to health disparities.

Most published literature on racial differences in PAD compares Black and White individuals, and relatively little evidence exists for disparities in people with PAD who are Hispanic, Native American, or Asian. Racial and ethnic groups are not homogenous, limiting the precision and accuracy of published evidence regarding racial and ethnic disparities.

PREVALENCE OF PAD BY RACE. Black people have an approximately 2-fold higher prevalence of PAD compared with White people.[2,4] A 2019 analysis that combined data from vital statistics and 6 U.S. community-based cohorts of >35,000 participants estimated that over an 80-year life span, lifetime risk for PAD was approximately 30.0% in Black men, 27.6% in Black women, 19% in White men, 19% in White women, and 22% in Hispanic men and women.[76]

DISPARITIES BY RACE IN PAD SIGNS AND SYMPTOMS. Black people have a higher prevalence of asymptomatic PAD and a higher prevalence of atypical leg symptoms.[77] In the WALCS cohort of 366 White

and 76 Black participants who had PAD without limb-threatening ischemia, asymptomatic PAD and exertional leg symptoms that sometimes begin at rest were significantly more common in people who were Black.[77] Compared with White people with PAD, Black people with PAD had lower ABI values (0.60 vs 0.66; $P = 0.001$), a higher prevalence of diabetes (46.8% vs 28.0%; $P = 0.001$), and lower prevalence of a college degree (13.7% vs 44.4%; $P < 0.001$).[77] People with PAD who were Black performed more poorly on each objective test of functioning, including 6-minute walk distance, normal-paced 4-m walking velocity, fast-paced 4-m walking velocity, and short physical performance battery compared with White people with PAD, but these differences were no longer statistically significant after adjustment for race differences in age, sex, education, ABI, and leg symptoms.[77] Among 1,162 people with PAD (26% Black) identified from Chicago-area medical centers and followed for a median of 46.0 months, Black race was associated with higher rates of becoming unable to walk continuously for 6 minutes, adjusting for age, sex, ABI, comorbidities, and other confounders (HR: 1.45; 95% CI: 1.05-1.99; $P = 0.022$).[78] This association was no longer statistically significant after additional statistical adjustment for income and education.[78] Similarly, a higher rate of mobility loss in people with PAD who were Black, compared with those with PAD who were White, was no longer significant after additional adjustment for income, education, and physical activity.[78] These results show the importance of social inequalities as factors explaining differences in walking impairment and functional decline between Black and White people with PAD.

RACE AND ATHEROSCLEROTIC DISEASE RISK FACTOR TREATMENT. Compared with White people Black people are less likely to receive guideline-directed management of cardiovascular disease risk factors.[79] Similar racial disparities in the secondary prevention of cardiovascular disease were reported for people with PAD.[80] Among 23,761 patients in the VQI with PAD (18% Black) who were hospitalized for lower extremity interventions, Black patients were less likely to be discharged on statin medications and antiplatelet therapy (64% vs 67%; $P < 0.001$) than White patients.[80] In the BEST-CLI (Best Endovascular vs Best Surgical Therapy in Patients With Chronic Limb-Threatening Ischemia) trial, compared with White participants, Black race was associated with significantly poorer rates of optimal medical therapy (defined as controlled blood pressure, at least 1 lipid-lowering drug, use of antiplatelet medication, and absence of current smoking), while Hispanic race was associated with significantly higher rates of optimal medical therapy compared with White participants.[81]

BLACK RACE AND WALKING EXERCISE FOR PAD. Despite greater functional impairment and higher rates of mobility loss in Black compared with White people with PAD, randomized clinical trials reported no significant differences in the benefits of supervised exercise or home-based walking exercise between Black and White people with PAD.[65,66] In combined data from 2 clinical trials of 308 participants with PAD that included 185 Black participants (59.9%), supervised treadmill exercise significantly improved 6-minute walk distance and treadmill walking time in people who were Black, and there were no significant differences in the benefits of supervised exercise on walking performance between Black and White participants with PAD.[65] Similar findings were reported regarding benefits of home-based exercise on walking performance in both Black and White participants in the GOALS (Group Oriented Arterial Leg Study) randomized clinical trial that included 194 participants, including 49.4% who were Black.[66]

Despite beneficial effects of supervised exercise for Black people with PAD, Black race was associated with significantly lower enrollment in CMS-covered supervised exercise.[82] In the Chicago metropolitan area, Black people with PAD were significantly more likely than White people with PAD to report unwillingness or inability to pay the $11 per exercise session copay required for CMS-covered supervised exercise, but this difference was no longer statistically significant after adjustment for ZIP code of residence, a proxy for socioeconomic status.[67] Poorer access to supervised exercise facilities, socioeconomic status, and other social factors likely present barriers to participation in supervised exercise in Black people with PAD.

BLACK RACE, LOWER EXTREMITY REVASCULARIZATION, AND AMPUTATION. Compared with White patients with PAD, Black patients with PAD have higher rates of amputation, higher rates of adverse outcomes after amputation or revascularization, and experience lower extremity revascularization and amputation at younger ages (**Table 3**).[83-92] Black patients undergoing procedures for PAD were more likely to have end-stage kidney disease, diabetes, heart failure, and hypertension than White patients.[80] In a retrospective study of Medicare patients who underwent amputation between 2003 and 2006, including 24,600 Black and 65,881 White patients, Black patients were

TABLE 3 Disparities in Amputation Rates in the United States

Group	Summary of Evidence
Sex	• In some studies, male sex has been associated with higher amputation rates
Race	• Black race has been consistently associated with higher amputation rates compared with White race among people with PAD • People with PAD who are Hispanic or Native American have higher rates of amputation compared with people who are White
Socioeconomic status	• Amputation rates are significantly higher in people with lower income compared with people with higher income
Geography	• Geographic differences in amputation rates are well documented, with high amputation rates occurring in the southeastern region of the United States

PAD = peripheral artery disease.

significantly less likely to have undergone lower extremity revascularization (23.6% vs 31.6%; $P < 0.001$), a limb-related hospitalization (39.6% vs 44.7%), or wound debridement (11.6% vs 14.2%) prior to amputation.[83] Black race remained significantly associated with lower rates of revascularization after adjusting for patient characteristics including comorbidities and socioeconomic status (OR: 0.72; 95% CI: 0.68-0.76), limb-related admission (OR: 0.81; 95% CI: 0.78-0.84), or wound debridement prior to amputation (OR: 0.80; 95% CI: 0.75-0.85).[83]

Among 90,418 patients in the VQI registry between 2003 and 2017 (17% Black), Black patients undergoing infrainguinal revascularization or amputation in 15 regions in the United States were younger and had a lower prevalence of smoking, coronary artery disease, or chronic obstructive pulmonary disease but had a higher prevalence of diabetes, limb-threatening ischemia, end-stage kidney disease, and hypertension compared with White patients. After 30 days, rates of mortality, MALE, and amputation were significantly higher in Black compared with White patients.[90] Other studies reported higher rates of early graft failure after lower extremity revascularization among Black compared with White patients.[84,87] In 1 study, Black women were at particularly high risk for major amputation and loss of graft patency after lower extremity revascularization.[84]

HISPANIC ETHNICITY, LOWER EXTREMITY REVASCULARIZATION, AND AMPUTATION. Hispanic patients with PAD are more likely than White patients with PAD to undergo amputation and have complications after lower extremity revascularization.[87-89,91,93] For example, among 5,599 White and 408 Hispanic patients in the VQI with chronic limb-threatening ischemia, Hispanic patients had higher rates of amputation (27% vs 19%), reintervention (70% vs 57%), and MALE (8.7% vs 4.9%) at 3-year follow-up.[88] Among patients hospitalized with PAD between 2011 and 2017 from the National Inpatient Sample, Hispanic patients had lower rates of revascularization and mortality but significantly higher rates of minor and major amputations compared with Non-Hispanic White patients.[93]

ASIAN RACE AND LOWER EXTREMITY REVASCULARIZATION. Few data on Asian race and PAD outcomes are available. In a VQI study of 80,312 White and 1,689 Asian patients from the United States, and Canada who underwent lower extremity revascularization and propensity matched pairs of Asian and White patients, Asian patients had a higher prevalence of chronic limb-threatening ischemia at revascularization (71% vs 66%; $P = 0.005$) and higher rates of in-hospital death and loss of primary patency at 18-month follow-up compared with White patients.[94] Overall, Asian patients were more likely to require an emergent lower extremity procedure than White patients (5.6% vs 1.7%; $P < 0.01$), but this phenomenon was not observed in the subset of patients treated in the United States.[94] A separate study comparing sex differences in outcomes among Chinese patients undergoing revascularization for chronic limb-threatening ischemia reported that women had poorer primary patency (33% vs 49% at 3 years; $P = 0.03$) and secondary graft patency rates (35% vs 64% at 3 years; $P = 0.02$) than men, which was attributed to the smaller caliber of tibial vessels in women.[9]

SOCIOECONOMIC DISPARITIES IN PAD PREVALENCE, INCIDENCE, AND OUTCOMES

Lower socioeconomic status and lower educational attainment have been associated with a higher prevalence and incidence of PAD.[95-97] Among 6,791 participants in NHANES (National Health and Nutrition Examination Survey) evaluated between 1999 and 2004, those with PAD were significantly less likely to have completed high school (69.6% vs 81.2%) or college (16.4% vs 26.5%) than those without PAD.[95] These associations of lower educational attainment with a higher prevalence of PAD were no longer statistically significant after adjustment for age, sex, race, atherosclerotic risk factors, and other potential confounders.[95] In the Chronic Renal Insufficiency Cohort of 3,313 adults with chronic kidney disease, lower annual household income was associated significantly with a higher incidence of PAD at a median follow-up of 10.1 years, adjusting for

confounders.[96] However, lower education was not associated with a higher incidence of PAD.[96] Among 12,517 participants in the ARIC (Atherosclerosis Risk In Communities) study without histories of PAD at baseline, lower income, lower educational attainment, and greater neighborhood deprivation were each associated with higher rates of hospitalization for PAD during a mean follow-up of 23.6 years.[97]

SOCIOECONOMIC STATUS AND AMPUTATION. Lower socioeconomic status was also associated with higher rates of chronic limb-threatening ischemia or amputation. In a meta-analysis of 11 observational studies that included 1,470,381 patients, lower socioeconomic status was associated with significantly higher rates of chronic limb-threatening ischemia and a higher rate of amputation after lower extremity revascularization compared with patients with higher socioeconomic status.[97] Other studies have also documented higher rates of major amputation and adverse outcomes after lower extremity revascularization in people with low socioeconomic status.[98-100] These associations were documented independently of race.[100]

People with lower socioeconomic status or lower educational attainment may have increased risk for adverse outcomes in PAD if they have less access to healthy lifestyles or high-quality health care. Mobility impairment and comorbid disease in PAD may make employment more difficult, potentially exacerbating an association of poorer socioeconomic status with PAD progression.

GEOGRAPHIC DISPARITIES IN PAD

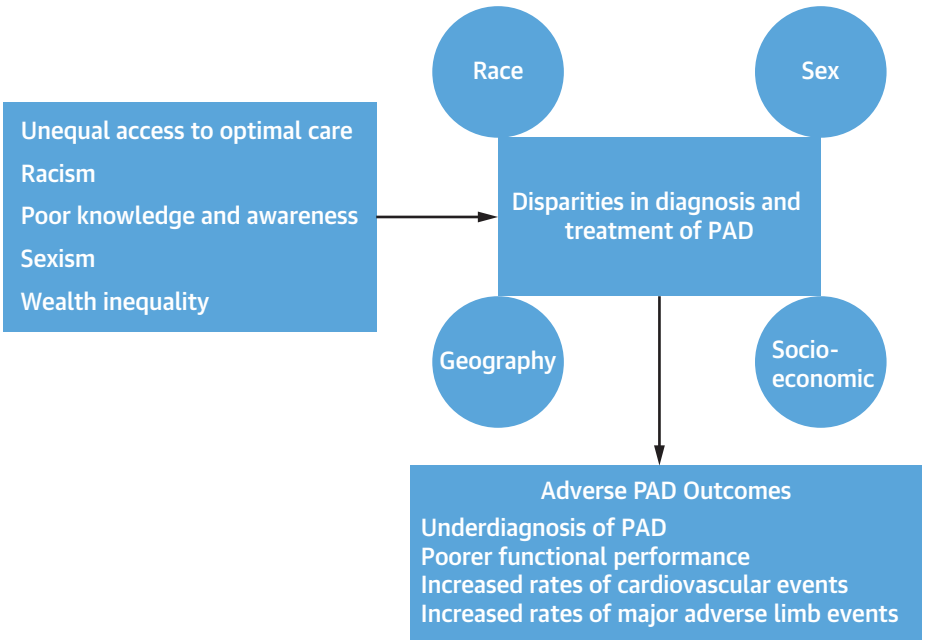
Among Medicare beneficiaries with symptomatic PAD, rates of enrollment in Medicare-covered supervised exercise therapy were significantly lower in the south Atlantic and southern regions of the United States compared with the northeastern and midwestern regions of the United States between June 1, 2017, and December 31, 2018.[82] Rates of major amputation differ by geographic region in the United States.[90,99,101-105] Among Medicare patients with PAD 65 years and older hospitalized between 2000 and 2008, amputation rates varied from 8,400 of 100,000 in the east south central region of the United States (ie, Alabama, Kentucky, Mississippi, and Tennessee) to 5,500 per 100,000 patients in the mountain area of the United States (ie, Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming).[105] Among Medicare patients with diabetes and PAD 65 years and older who were hospitalized between 2007 and 2011, the mean amputation rate overall was 2.4 per 1,000 hospitalized patients but varied significantly by region, from 1.3 per 1,000 in Royal Oak, Michigan, to 6.2 per 1,000 in Tupelo, Mississippi.[101] Although amputation rates were higher in the southeastern region of the United States, rates of amputation varied even within specific geographic areas.[101] Geographic differences in amputation rates were also reported by race. Among Black patients with PAD, rates of amputation-free survival varied from 53.7% in Savannah, Georgia, to 76.7% in Gary, Indiana, at 2-year follow-up. Among White patients with PAD, amputation-free survival varied from 64.9% in Appleton, Wisconsin, to 83% in Yakima, Washington, at 2-year follow-up.[101] Between 2010 and 2018, among 188,995 Medicare beneficiaries, 78.5% of amputations occurred in metropolitan ZIP codes, but rates of amputation were highest in rural ZIP codes.[99] Amputation rates were 363 of 100,000 in rural ZIP codes, 351 of 100,000 in micropolitan ZIP codes, and 315 of 100,000 in metropolitan ZIP codes.[99]

GEOGRAPHY, MEDICAL CARE ACCESS, AND OUTCOMES IN PAD. In Texas, rural communities with more primary care clinicians had significantly lower rates of amputation per 100,000 residents, suggesting that access to primary care was associated with lower amputation rates.[102] In North Carolina, amputation rates were 4.15% in medically underserved counties, compared with 3.03% in counties not medically underserved.[103] Medically underserved counties had significantly fewer clinicians than those not underserved, and no vascular surgeons practiced in any underserved counties.[103] Interventional radiologists disproportionately practice in urban compared with rural settings (1.30 of 100,000 people in metropolitan counties compared with 0.57 of 100,000 in rural counties).[106] Although causal inferences cannot be made from observational data, these results suggest that geographic disparities in PAD treatment may relate to lack of adequate primary care, vascular surgery, and other clinicians with vascular disease expertise in underserved regions of the United States.

REDUCING DISPARITIES IN PAD

In considering strategies to overcome differences in the prevalence, diagnosis, and treatment of PAD, one should distinguish between disparities that can be reduced or eliminated, such as inadequate access to health care in resource limited settings, and those that may not be possible to eliminate, such as sex differences in skeletal muscle mass, which contribute to sex differences in walking performance among people with PAD. Overcoming disparities related to racism, bias, and lack of PAD awareness will require

CENTRAL ILLUSTRATION **Disparities and Outcomes in Peripheral Artery Disease**



McDermott MM, et al. J Am Coll Cardiol. 2023;82(24):2312–2328.

Disparities in the diagnosis and treatment of patients with peripheral artery disease (PAD) exist by sex, race, socioeconomic status, and geography. These disparities are multifactorial and complex but likely develop from problems that include unequal access to optimal health care; racism; sexism; inadequate knowledge, awareness, and appreciation of PAD; and wealth inequality. Disparities in diagnosis and treatment of PAD are expected to contribute to adverse outcomes in patients with PAD, which include underdiagnosis of PAD, greater functional impairment, higher rates of cardiovascular events, and higher rates of major adverse lower extremity events. Intentional interventions to eliminate disparities in PAD are expected to lower rates of these adverse outcomes in people with PAD.

intentional interventions such as scientific investigation, workforce development, and health care policies to address inequities. These interventions should be comprehensive, flexible, and durable. Ending structural racism will facilitate the study of PAD in a manner that is more accurate and appropriate than simple racial groups. In the following paragraphs, we propose strategies to overcome PAD disparities (**Central Illustration**, **Table 4**).

NOMENCLATURE AND PAD. Both the general population and patients with PAD are often unfamiliar with simple facts regarding PAD, including the significance of PAD with regard to risk for myocardial infarction or stroke.[107,108] The term "peripheral artery disease" may imply that PAD is neither central nor of primary importance. An alternative name that depicts PAD as part of a systemic process that includes an increased risk for stroke, myocardial infarction, amputation, and mobility impairment may be more effective than "peripheral artery disease." Developing educational messages about PAD with input from patient focus groups is important to effectively communicate the significance of PAD.

LACK OF KNOWLEDGE AND AWARENESS OF PAD. Knowledge about PAD is poor among patients, the public, and clinicians.[107-109] In a 2007 telephone survey conducted in the United States, only 25% of the public knew that people with PAD had higher rates of heart attack or stroke, and only 14% knew that PAD was associated with limb amputation.[108] In a national U.S. survey of physicians in the early 21st century, physicians were significantly more likely to report that it was very important to treat a patient with coronary artery disease with antiplatelet therapy or cholesterol-lowering therapy compared with a patient with PAD.[109] More recently, only 65.4% of 70 patients with PAD recruited from the vascular surgery practice of an academic medical center were aware of their PAD diagnoses.[107] Lack of PAD awareness may accentuate disparities by contributing to lower rates

TABLE 4 Proposed Solutions to Reduce Disparities in PAD

Domains	Sex	Race	Socioeconomic Status	Geography
Clinician factors	• Increase knowledge among clinicians that PAD is common and may be associated with worse outcomes in women • Increase knowledge regarding atypical presentations in women	• Increase knowledge among clinicians of the high prevalence of PAD in people who are Black or Native American • Increase knowledge among clinicians regarding atypical presentations in Black people with PAD	• Address economic determinants of health during clinical visits	• Improve clinician awareness of optimal medical care in all geographic settings • Use telemedicine approaches to reach patients in remote geographic settings
Population factors	• Increase awareness of disparities that exist in diagnosis and management of PAD.			
Patient factors	• Increase awareness of typical and atypical symptoms of PAD in women	• Increase awareness of typical and atypical PAD symptoms in Black people and non-White races	• Increase awareness of health insurance coverage options	• Improve access to high-quality health care
Health policy	• Ensure that women have access to affordable and effective treatments	• Reimburse PAD screening in high-risk populations • Improve access to healthy food, safe areas to exercise, and higher education • Reduce segregation by race	• Reduce rates of poverty • Reduce income disparities • Reduce segregation by income	• Reimburse PAD screening in high-risk communities
Access to healthy food and areas to exercise	• Ensure access to healthy foods in women and men • Improve access to exercise interventions	• Improve access to healthy foods • Improve access to safe neighborhoods • Improve access to higher education	• Improve access to healthy foods • Improve access to safe neighborhoods.	• Improve access to effective exercise interventions
Medical care access	• Improve awareness and acceptance of gender diversity in patients with PAD	• Improved access to primary care • Ensure equitable access to high-quality care • Improve awareness and acceptance of diverse cultures	• Increase availability of primary care	• Improve access to telemedicine
Scientific investigation	• Ensure that women with PAD are included in randomized trials • Investigate whether different endovascular devices may be more effective in women • Identify barriers to prescribing preventive therapies in women • Identify barriers to medication adherence in women with PAD • Identify barriers to participation in supervised exercise in women with PAD • Increased evidence on causes of gender-related differences in PAD	• Ensure racial diversity among participants in randomized clinical trials of PAD patients • Identify barriers to prescribing preventive medications in patients with PAD who are Black or from other under-represented minority groups • Identify barriers to participating in exercise programs in people with PAD who are Black or from other under-represented minority groups • Identify barriers to access to high-quality care in people with PAD who are Black or from other under-represented minority groups • Study interventions to eliminate structural racism to overcome racial disparities in diagnosis and treatment • Develop a measure of structural racism to be used in randomized clinical trials	• Ensure diversity in socioeconomic status among participants in randomized trials • Design affordable options for high-quality PAD care	• Ensure access to high-quality PAD care that involves delivering care to people where they are

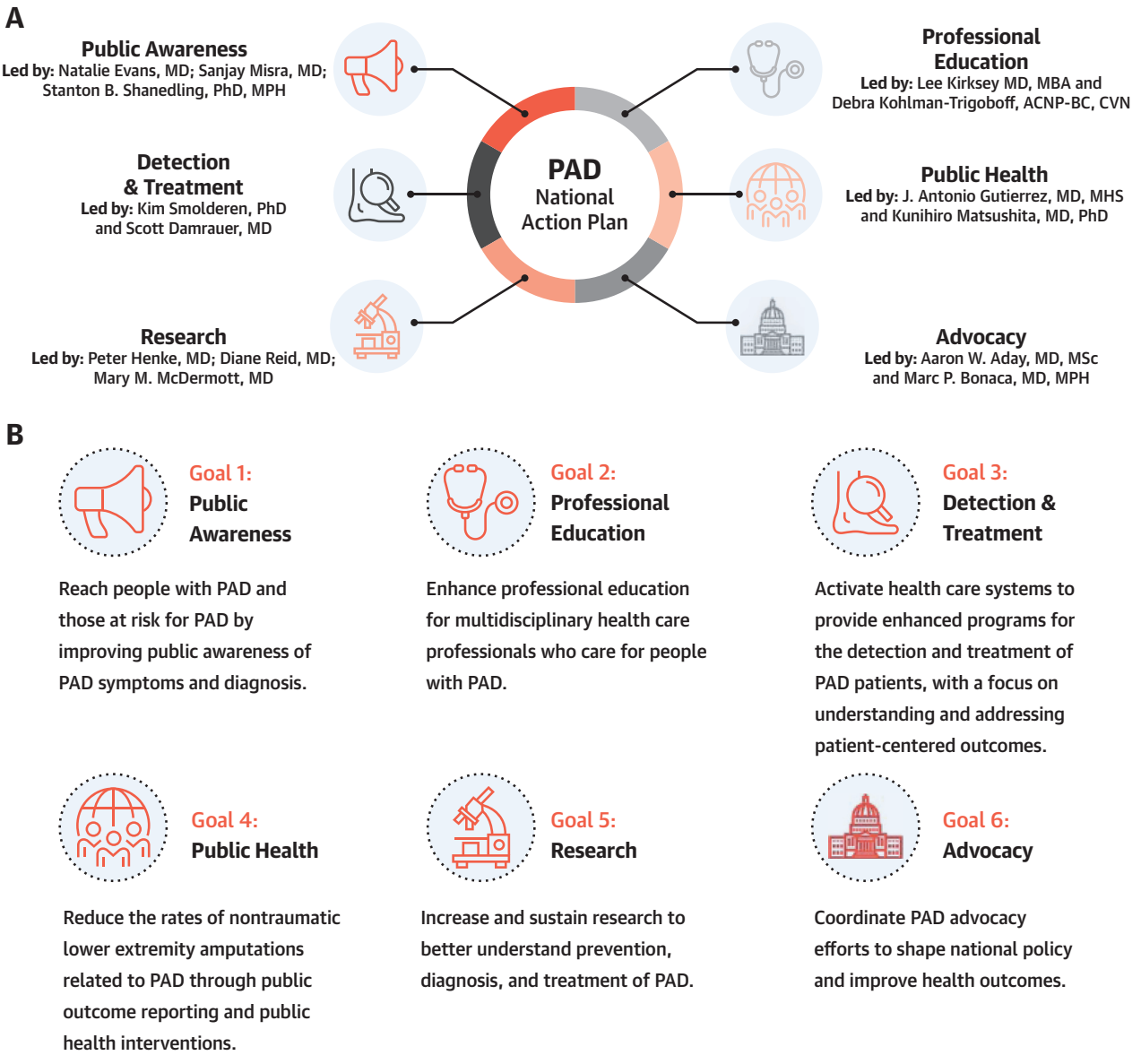
PAD = peripheral artery disease.

of PAD diagnosis, prevention, and optimal treatment. Further study is needed to determine whether improving knowledge about PAD among clinicians and the public reduces disparities in PAD diagnosis and treatment.

PAD NATIONAL ACTION PLAN. The PAD National Action Plan was developed to eliminate disparities in care of people with PAD and improve awareness, detection, and treatment of PAD through collaborative multidisciplinary efforts from organizations, patients, and clinicians.[110] The National Action Plan includes 27 action items and 101 specific methods organized into the following 6 disciplines: public awareness, professional education, detection and treatment, public health, research, and advocacy (Figure 1). In addition to improving clinician, patient, and public knowledge and awareness of PAD through publicly available resources, the National Action Plan is intended to overcome barriers to prevention and optimal treatment of PAD and define and improve quality of life for people with PAD.

IMPROVING PAD AWARENESS. Awareness campaigns may reduce disparities by disseminating knowledge about PAD that may empower patients to seek health care for PAD-related signs and symptoms. Effective awareness campaigns should use culturally appropriate language that is easy for patients and the public to understand.[107,108] Although awareness campaigns should be widely disseminated, they may be most effective in communities with the highest

FIGURE 1 Overview of the PAD National Action Plan



The Peripheral Artery Disease (PAD) National Action Plan, originally developed by the American Heart Association, aims to improve awareness, diagnosis, and treatment of PAD. The National Action Plan is a multidisciplinary effort with 6 components. The overarching goal is to improve patient and physician awareness of PAD, increase testing for and detection of PAD, and reduce mortality and amputations associated with PAD. The National Action Plan includes 6 subcommittees focusing on public awareness, professional education, detection and treatment, public health, research, and advocacy (A). (B) Summary of the work in each of the 6 domains. Reproduced with permission from the American Heart Association.[110]

prevalence of undiagnosed PAD and highest incidence of lower extremity amputations. A preliminary study that included ABI testing in 2 Cleveland barbershops identified PAD in 5 of 31 Black men (16.1%) and improved knowledge of PAD among the barbershop patrons.[111] Places of worship, social media, and community organizations and events may be useful venues for PAD awareness campaigns.

INITIATIVES TO REDUCE PAD DISPARITIES. Six initiatives are proposed here to improve PAD awareness, diagnosis, and outcomes. First, a "heat" map could be

created to illustrate locations of communities with the highest amputation rates and prevalence of PAD. This map would communicate the geographic areas needing attention and assistance to improve PAD detection and treatment.

Second, because of the high prevalence of PAD with atypical symptoms and asymptomatic PAD, clinicians should ask all patients older than 50 years about walking ability and leg symptoms during walking.

Third, patients and the public should be educated that leg discomfort, weakness, and declining ability to walk longer distances may indicate the presence of PAD. Improving awareness of typical signs and symptoms of PAD would be an important goal for Healthy People 2030. People with symptoms of PAD should be tested using the ABI.

Fourth, individuals with histories of heart disease, stroke, diabetes, or tobacco use are at higher risk for PAD and should undergo ABI testing. Clinicians should be reminded to ask patients to "take the socks off" to facilitate PAD diagnosis in high-risk individuals.

Fifth, opportunities to participate in supervised exercise and effective home-based exercise programs should be widely accessible. Ultimately, accessible and affordable high-quality health care that is acceptable to patients should be made available to all people with PAD (**Figure 1**).[112]

Sixth, efforts should be made to ensure the representation of women and people of lower socioeconomic status in randomized clinical trials. Similarly, efforts should be made to maximize participation in randomized clinical trials by people who are Black, Hispanic, Asian, American Indian, and other racial and ethnic minorities in the United States.

In addition to these 6 specific initiatives, interventions to overcome structural racism, sexism, and inherent bias are necessary to reduce disparities in PAD.

STUDY LIMITATIONS

First, some included literature was older and may be less relevant in 2023. Second, not all relevant studies were included, because of space limitations. Third, the quality of included papers was not formally assessed.

Fourth, few studies were identified for some racial and ethnic groups, such as Native Americans, Hispanic, and Asian populations. Fifth, no studies were identified on the association of socioeconomic status with optimal diagnosis and treatment of PAD. Sixth, although disparities in PAD diagnosis and treatment exist worldwide, this review is focused on disparities within the United States.

SUMMARY, GAPS, AND FUTURE DIRECTIONS

Disparities in the diagnosis and management of PAD exist by sex, race, socioeconomic status, and geography. Racial disparities are greatest for Black people, although further study is needed to better define the extent of disparities in other racial and ethnic groups. Disparities in the diagnosis and treatment of patients with PAD are likely to contribute to higher rates of adverse outcomes, including cardiovascular events, MALE, mobility impairment, and amputation, in people with PAD. Gaps in knowledge include a lack of sufficient information regarding the reasons for disparities; the extent of disparities for people with PAD who are Hispanic, Asian, Native American, and other races or ethnicities; and the most optimal interventions to eliminate disparities. Future work should focus on developing intentional interventions directed toward clinicians, scientists, patients, the health care system, and health policy to eliminate disparities in PAD.

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REFERENCES

1. Song P, Rudan D, Zhu Y, et al. Global, regional, and national prevalence and risk factors for peripheral artery disease in 2015: an updated systematic review and analysis. *Lancet Glob Health*. 2019;7:e1020–e1030.

2. Allison MA, Ho E, Denenberg JO, et al. Ethnic-specific prevalence of peripheral arterial disease in the United States. *Am J Prev Med*. 2007;32:328–333.

3. Unkart JT, Allison MA, Araneta MRG, et al. Burden of peripheral artery disease on mortality and incidence cardiovascular events. The Multi-Ethnic Study of Atherosclerosis. *Am J Epidemiol*. 2020;189:951–962.

4. Criqui MH, Aboyans V. Epidemiology of peripheral artery disease. *Circ Res*. 2015;116:1509–1526.

5. Bonaca MP, Nault P, Giugliano RP, et al. Low-density lipoprotein cholesterol lowering with evolocumab and outcomes in patients with peripheral artery disease: insights from the FOURIER trial. *Circulation*. 2018;137:338–350.

6. McDermott MM, Guralnik JM, Tian L, et al. Associations of borderline and low normal ankle-brachial index values with functional decline at 5-year follow-up: the WALCS (Walking and Leg Circulation Study). *J Am Coll Cardiol*. 2009;53:1056–1062.

7. McDermott MM, Applegate WB, Bonds DE, et al. Ankle brachial index values, leg symptoms, and functional performance among community-dwelling older men and women in the lifestyle interventions and independence for elders study. *J Am Heart Assoc*. 2013;2:e000257.

8. Criqui MH, Matsushita K, Aboyans V, et al. Lower extremity peripheral artery disease: contemporary epidemiology, management gaps, and future directions: a scientific statement from the American Heart Association. *Circulation*. 2021;144:e171–e191.

9. AhChong AK, Chiu KM, Wong M, et al. The influence of gender difference on the outcomes of infrainguinal bypass for critical limb ischemia in Chinese patients. *Eur J Vasc Endovasc Surg*. 2002;23:134–139.

10. Demsas F, Joiner M, Telma K, et al. Disparities in peripheral artery disease care: a review and call for action. *Semin Vasc Surg*. 2022;35:141–154.

11. Pabon M, Cheng S, Altin SE, et al. Sex differences in peripheral artery disease. *Circ Res*. 2022;130:496–511.

12. Ding N, Sang Y, Chen J, et al. Cigarette smoking, smoking cessation, and long-term risk of 3 major atherosclerotic diseases. *J Am Coll Cardiol*. 2019;74:498–507.

13. Joosten MM, Pai JK, Bertoia ML, et al. Associations between conventional cardiovascular risk factors and risk of peripheral artery disease in men. *JAMA*. 2012;308:1660–1667.

14. Allison MA, Criqui MH, McClelland RL, et al. The effect of novel cardiovascular risk factors on the ethnic-specific odds for peripheral arterial disease in the Multi-Ethnic Study of Atherosclerosis (MESA). *J Am Coll Cardiol*. 2006;48:1190–1197.

15. Allison MA, Peralta CA, Wassel CL, et al. Genetic ancestry and lower extremity peripheral artery disease in the Multi-Ethnic Study of Atherosclerosis. *Vasc Med*. 2010;15:351–359.

16. Ix JH, Allison MA, Denenberg JO, et al. Novel cardiovascular risk factors do not completely explain the higher prevalence of peripheral arterial disease among African Americans. The San Diego Population Study. *J Am Coll Cardiol*. 2008;51:2347–2354.

17. Aboyans V, Criqui MH, McClelland RL, et al. Intrinsic contribution of gender and ethnicity to normal ankle-brachial index values: the Multi-Ethnic Study of Atherosclerosis (MESA). *J Vasc Surg*. 2007;45:319–327.

18. Hobbs SD, Wilmink AB, Bradbury AW. Ethnicity and peripheral arterial disease. *Eur J Vasc Endovasc Surg*. 2003;25:505–512.

19. Fabsitz RR, Sidawy AN, Go O, et al. Prevalence of peripheral arterial disease and associated risk factors in American Indians: the Strong Heart Study. *Am J Epidemiol*. 1999;149:330–338.

20. Curb JD, Masaki K, Rodriguez BL, et al. Peripheral artery disease and cardiovascular risk factors in the elderly. The Honolulu Heart Program. *Arterioscler Thromb Vasc Biol*. 1996;16:1495–1500.

21. Allison MA, Gonzalez F II, Raij L, et al. Cuban Americans have the highest rates of peripheral arterial disease in diverse Hispanic/Latino communities. *J Vasc Surg*. 2015;62:665–672.

22. Gerhard-Herman MD, Gornik HL, Barrett C, et al. 2016 AHA/ACC guideline on the management of patients with lower extremity peripheral artery disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2017;69(11):e71–e126.

23. Ruiz-Canela M, Estruch R, Corella D, et al. Association of Mediterranean diet with peripheral artery disease: the PREDIMED randomized trial. *JAMA*. 2014;311:415–417.

24. Kalbaugh CA, Gonzalez NJ, Luckett DJ, et al. The impact of current smoking on outcomes after infrainguinal bypass for claudication. *J Vasc Surg*. 2013;68:495–502.

25. Polonsky TS, McDermott MM. Lower extremity peripheral artery disease without chronic limb-threatening ischemia: a review. *JAMA*. 2021;325:2188–2198.

26. Nissen SE, Lincoff AM, Brennan D, et al. Bempedoic acid and cardiovascular outcomes in statin-intolerant patients. *N Engl J Med*. 2023;388:1343–1364.

27. Yusuf S, Sleight P, Pogue J, et al. for the Heart Outcomes Prevention Evaluation Study Investigators. Effects of an angiotensin-converting-enzyme inhibitor, ramipril, on cardiovascular events in high-risk patients. *N Engl J Med*. 2000;342:145–153.

28. Narcisse DI, Katzenberger DR, Gutierrez JA. Contemporary medical therapies for patients with peripheral artery disease and concomitant type 2 diabetes mellitus: a review of current evidence. *Curr Cardiol Rep*. 2022;24:567–576.

29. Dhatariya K, Bain SC, Buse JB, et al. The impact of liraglutide on diabetes-related foot ulceration and associated complications in patients with type 2 diabetes at high risk for cardiovascular events: results from the LEADER trial. *Diabetes Care*. 2018;41:2229–2235.

30. Scheen AJ. Lower limb amputations: protection with GLP-1 receptor agonists rather than increased risk with SGLT2 inhibitors? *Diabetes Metab*. 2022;48:101325.

31. Berger JS, Krantz MJ, Kittelson JM, et al. Aspirin for the prevention of cardiovascular events in patients with peripheral artery disease: a meta-analysis of randomized trials. *JAMA*. 2009;301:1909–1919.

32. CAPRIE Steering Committee. A randomized, blinded, trial of clopidogrel versus aspirin in patients at risk of ischaemic events (CAPRIE). *Lancet*. 1996;348:1329–1339.

33. Anand SS, Caron F, Eikelboom JW, et al. Major adverse limb events and mortality in patients with peripheral artery disease: the COMPASS trial. *J Am Coll Cardiol*. 2018;71:2306–2315.

34. McDermott MM. Lower extremity manifestations of peripheral artery disease: the

pathophysiologic and functional implications of leg ischemia. *Circ Res*. 2015;116:1540–1550.

35. McDermott MM, Greenland P, Liu K, et al. The ankle brachial index is associated with leg function and physical activity: the Walking and Leg Circulation Study. *Ann Intern Med*. 2002;136:873–883.

36. McDermott MM, Liu K, Greenland P, et al. Functional decline in peripheral arterial disease: associations with the ankle brachial index and leg symptoms. *JAMA*. 2004;292:453–461.

37. McDermott MM, Spring B, Tian L, et al. Effect of low-intensity vs high-intensity home-based walking exercise on walk distance in patients with peripheral artery disease: the LITE randomized clinical trial. *JAMA*. 2021;325:1266–1276.

38. Lee C, Nelson PR. Effect of cilostazol prescribed in a pragmatic treatment program for intermittent claudication. *Vasc Endovasc Surg*. 2014;48:224–229.

39. Visser M, Goodpaster BH, Kritchevsky SB, et al. Muscle mass, muscle strength, and muscle fat infiltration as predictors of incident mobility limitations in well-functioning older persons. *J Gerontol Med Sci*. 2005;60A:324–333.

40. Braun JD, Kougias P. The ever-humbling challenge of peripheral artery disease treatment seen across the sexes. *J Am Heart Assoc*. 2019;8:e013813.

41. Morrison A, Aday AW. Sex as a key determinant of peripheral artery disease: epidemiology, differential outcomes, and proposed biological mechanisms. *Can J Cardiol*. 2022;38:601–611.

42. Selvin E, Erlinger TP. Prevalence of and risk factors for peripheral arterial disease in the United States: results from the National Health and Nutrition Examination Survey, 1999-2000. *Circulation*. 2004;110:738–743.

43. McDermott MM, Liu K, Criqui MH, et al. Ankle-brachial index and subclinical cardiac and carotid disease: the multi-ethnic study of atherosclerosis. *Am J Epidemiol*. 2005;162:33–41.

44. McDermott MM, Fried L, Simonsick E, Ling S, Guralnik JM. Asymptomatic peripheral arterial disease is independently associated with impaired lower extremity functioning: the Women's Health and Aging Study. *Circulation*. 2000;101:1007–1012.

45. McDermott MM, Greenland P, Liu K, et al. Sex differences in peripheral arterial disease: leg symptoms and physical functioning. *J Am Geriatr Soc*. 2003;51(2):222–228.

46. Collins TC, Suarez-Almazor M, Bush RL, et al. Gender and peripheral arterial disease. *J Am Board Fam Med*. 2006;19:132–140.

47. Porras CP, Bots ML, Teraa M, et al. Differences in symptom presentation in women and men with confirmed lower limb peripheral artery disease: a systematic review and meta-analysis. *Eur J Vasc Endovasc Surg*. 2022;63:602–612.

48. Sigvant B, Wiberg-Hedman K, Bergqvist D, et al. A population-based study of peripheral arterial disease prevalence with special focus on critical limb ischemia and sex differences. *J Vasc Surg*. 2007;45:1185–1191.

49. McDermott MM, Guralnik JM, Ferrucci L, et al. Asymptomatic peripheral arterial disease is associated with more adverse lower extremity characteristics than intermittent claudication. *Circulation*. 2008;117:2484–2491.

50. Gardner AW. Sex differences in claudication pain in subjects with peripheral arterial disease. *Med Sci Sports Exerc*. 2002;34:1695–1698.

51. McDermott MM, Ferrucci L, Liu K, et al. Women with peripheral arterial disease experience faster functional decline than men with peripheral arterial disease. *J Am Coll Cardiol*. 2011;57:707–714.

52. Gardner AW, Parker DE, Montgomery PS, et al. Sex differences in calf muscle hemoglobin oxygen saturation in patients with intermittent claudication. *J Vasc Surg*. 2009;50:77–82.

53. Visser M, Kritchesky SB, Goodpaster BH, et al. Leg muscle mass and composition in relation to lower extremity performance in men and women aged 70 to 79: the Health, Aging, and Body Composition Study. *J Am Geriatr Soc*. 2002;50:897–904.

54. Roumia M, Aronow HD, Soukas P, et al. Sex differences in disease-specific health status measures in patients with symptomatic peripheral artery disease: data from the PORTRAIT study. *Vasc Med*. 2017;22:103–109.

55. McDermott MM, Guralnik JM, Tian L, et al. Incidence and prognostic significance of depressive symptoms in peripheral artery disease. *J Am Heart Assoc*. 2016;5:e002959.

56. Smolderen KG, Spertus JA, Vriens PW, et al. Younger women with symptomatic peripheral arterial disease are at increased risk of depressive symptoms. *J Vasc Surg*. 2010;52:637–644.

57. Brostow DP, Petrik ML, Sarosta AJ, Waldo SW. Depression in patients with peripheral arterial disease, a systematic review. *Eur J Cardiovasc Nurs*. 2017;16(3):181–193.

58. Allabadi H, Probst-Hensch N, Alkaiyat A, et al. Mediators of gender effects on depression among cardiovascular disease patients in Palestine. *BMC Psychiatry*. 2019;19:284.

59. Mahtta D, Ahmed ST, Ramsey DJ, et al. Statin prescription rates, adherence, and associated clinical outcomes among women with PAD and ICVD. *Cardiovasc Drugs Ther*. 2020;34:745–754.

60. McDermott MM, Greenland P, Reed G, et al. Gender differences in cholesterol-lowering medication prescribing in peripheral artery disease. *Vasc Med*. 2011;16:428–435.

61. Lo RC, Bensley RP, Dahlberg SE, et al. Presentation, treatment, and outcome differences between men and women undergoing revascularization or amputation for lower extremity peripheral arterial disease. *J Vasc Surg*. 2014;59:409–418.

62. Singh N, Ding L, Devera J, et al. Prescribing of statins after lower extremity revascularization procedures in the US. *JAMA Netw Open*. 2021;4:e2136014.

63. McGinigle KL, Browder SE, Strassle PD, et al. Sex-related disparities in intervention rates and type of intervention in patients with aortic and peripheral arterial diseases in the National Inpatient Sample database. *J Vasc Surg*. 2021;73:2081–2089.

64. Berger JS, Ladapo JA. Underuse of prevention and lifestyle counseling in patients with peripheral artery disease. *J Am Coll Cardiol*. 2017;69:2293–2300.

65. Patel K, Polonsky TS, Kibbe MR, et al. Clinical characteristics and response to supervised exercise therapy of people with lower extremity peripheral artery disease. *J Vasc Surg*. 2021;73:608–625.

66. McDermott MM, Liu K, Guralnik JM, et al. Home-based walking exercise intervention in peripheral artery disease: a randomized clinical trial. *JAMA*. 2013;310:57–65.

67. Cetlin MD, Polonsky T, Ho K, et al. Barriers to participation in supervised exercise therapy reported by people with peripheral artery disease. *J Vasc Surg*. 2022;77:506–514.

68. Ramkumar N, Suckow BD, Brown JR, et al. Role of sex in determining treatment type for patients undergoing endovascular lower extremity revascularization. *J Am Heart Assoc*. 2019;8:e013088.

69. Levin SR, Farber A, King EG, et al. Female sex is associated with more reinterventions after endovascular and open interventions for intermittent claudication. *Ann Vasc Surg*. 2022;86:85–93.

70. Ballotta E, Gruppo M, Lorenzetti R, et al. The impact of gender on outcome after infrainguinal arterial reconstructions for peripheral occlusive disease. *J Vasc Surg*. 2012;56:343–352.

71. Eugster T, Gürke L, Obeid T, et al. Infrainguinal arterial reconstruction: female gender as risk factor for outcome. *Eur J Vasc Endovasc Surg*. 2002;24:245–248.

72. Wang J, He Y, Shu C, et al. The effect of gender on outcomes after lower extremity revascularization. *J Vasc Surg*. 2017;65:889–906.

73. Jackson EA, Munir K, Schreiber T, et al. Impact of sex on morbidity and mortality rates after lower extremity interventions for peripheral arterial disease. *J Am Coll Cardiol*. 2014;63:2525–2530.

74. Vouyouka AG, Egorova NN, Salloum A, et al. Lessons learned from the analysis of gender effect on risk factors and procedural outcomes of lower extremity arterial disease. *J Vasc Surg*. 2010;52:1196–1203.

75. Churchwell K, Elkind MSV, Benjamin RM, et al. Call to action: structural racism as a fundamental driver of health disparities: a presidential advisory from the American Heart Association. *Circulation*. 2020;142:e454–e468.

76. Matsushita K, Sang Y, Ning H, et al. Lifetime risk of lower extremity peripheral artery disease defined by ankle-brachial index in the United States. *J Am Heart Assoc*. 2019;8:e012177.

77. Rucker-Whitaker C, Greenland P, Liu K, et al. Peripheral arterial disease in African Americans: clinical characteristics, leg symptoms, and lower extremity functioning. *J Am Geriatr Soc*. 2004;52:922–930.

78. McDermott MM, Polonsky TS, Kibbe MR, et al. Racial differences in functional decline in peripheral artery disease and associations with socioeconomic status and education. *J Vasc Surg*. 2017;66:826–834.

79. Dorsch MP, Lester CA, Ding Y, et al. Effects of race on statin prescribing for primary prevention with high atherosclerotic cardiovascular disease risk in a large healthcare system. *J Am Heart Assoc*. 2019;8:e014709.

80. Soden PA, Zettervall SL, Deery SE, et al. Black patients present with more severe vascular disease and a greater burden of risk factors than White patients at the time of major vascular intervention. *J Vasc Surg*. 2018;67:549–557.

81. Menard MT, Jaff MR, Farber A, et al. Baseline modern medical management in the BEST-CLI trial. *J Vasc Surg*. 2023;78:711–718.

82. Divakaran S, Carroll BJ, Chen S, et al. Supervised exercise therapy for symptomatic peripheral artery disease among Medicare beneficiaries between 2017 and 2018: participation rates and outcomes. *Circ Cardiovasc Qual Outcomes*. 2021;14:e007953.

83. Holman KH, Henke PK, Dimick JB, et al. Racial disparities in use of revascularization before leg amputation in Medicare patients. *J Vasc Surg*. 2011;54:420–426.

84. Nguyen LL, Hevelone N, Rogers SO, et al. Disparity in outcomes of surgical revascularization for limb salvage. *Circulation*. 2008;119:123–130.

85. Chen L, Zhang D, Shi L, et al. Disparities in peripheral artery disease hospitalizations identified among understudied race-ethnicity groups. *Front Cardiovasc Med*. 2021;8:692236.

86. Pandit V, Brown T, Bhogadi SK, et al. The association of social and ethnic disparities and frailty in geriatric patients undergoing revascularization for peripheral artery disease. *Semin Vasc Surg*. 2023;36:78–83.

87. Selvarajah S, Black JH III, Haider AH, et al. Racial disparities in early graft failure after infrainguinal bypass. *J Surg Res*. 2014;190:335–353.

88. Anjorin AC, Marcaccio CL, Patel PB, et al. Racial and ethnic disparities in 3-year outcomes following infrainguinal bypass for chronic limb-threatening ischemia. *J Vasc Surg*. 2022;76:1335–1346.

89. Kalbaugh CA, Witrick B, Sivaraj LB, et al. Non-Hispanic Black and Hispanic patients have worse outcomes than White patients within similar stages of peripheral artery disease. *J Am Heart Assoc*. 2022;11, 10.e023396.

90. O'Donnell TFX, Powell C, Deery SE, et al. Regional variation in racial disparities among patients with peripheral artery disease. *J Vasc Surg*. 2018;68:519–526.

91. Loja MN, Brunson A, Li CS, et al. Racial disparities in outcomes of endovascular procedures for peripheral arterial disease: an evaluation of California hospitals, 2005-2008. *Ann Vasc Surg*. 2015;29:950–959.

92. Provance JB, Spertus JA, Jones PG, et al. Variability in 30-day major amputation rates following endovascular peripheral vascular intervention for critical limb ischemia. *Vasc Med*. 2022;4:350–357.

93. Luna P, Harris K, Castro-Dominguez Y, et al. Risk profiles, access to care, and outcomes in Hispanics hospitalized for lower extremity peripheral artery disease. *J Vasc Surg*. 2023;77:216–224.

94. Chen P, Patel PB, Ding J, et al. Asian race is associated with peripheral arterial disease severity and postoperative outcomes. *J Vasc Surg*. 2023;78(1):175–183.e3.

95. Pande RL, Creager MA. Socioeconomic inequality and peripheral artery disease prevalence in US adults. *Circ Cardiovasc Qual Outcomes*. 2014;7:532–539.

96. Stoecker JB, Cohen JB, Belkin N, et al. The association between socioeconomic factors and incident peripheral artery disease in the Chronic Renal Insufficiency Cohort (CRIC). *Ann Vasc Surg*. 2022;80:196–205.

97. Lee MH, Li PY, Li B, et al. Lower socioeconomic status is associated with higher rates of critical limb ischemia presentation and post-revascularization amputation. *J Vasc Surg*. 2022;75:1121–1122.

98. Hughes K, Olufajo OA, White K, et al. The influence of socioeconomic status on outcomes of lower extremity arterial reconstruction. *J Vasc Surg*. 2022;75:168–176.

99. Fanaroff AC, Yang L, Nathan AS, et al. Geographic and socioeconomic disparities in major lower extremity amputation rates in metropolitan areas. *J Am Heart Assoc*. 2021;10:e021456.

100. Arya S, Binney Z, Khakharia A, et al. Race and socioeconomic status independently affect risk of major amputation in peripheral artery disease. *J Am Heart Assoc*. 2018;7:e007425.

101. Newhall K, Spangler E, Dzebisashvili N, et al. Amputation rates for patients with diabetes and peripheral arterial disease: the effects of race and region. *Ann Vasc Surg*. 2016;30:292–298.

102. Cao J, Sharath SE, Zamani N, et al. Health care resource distribution of Texas counties with high rates of leg amputations. *J Surg Res*. 2019;243:213–219.

103. McGinigle KL, Kalbaugh CA, Marston WA. Living in a medically underserved county is an independent risk factor for major limb amputation. *J Vasc Surg*. 2014;59:737–741.

104. Minc SD, Hendricks B, Misra R, et al. Geographic variation in amputation rates among patients with diabetes and/or peripheral arterial disease in the rural state of West Virginia identifies areas for improved care. *J Vasc Surg*. 2020;71:1708–1717.e5.

105. Schuyler Jones W, Patel MR, Dai D, et al. Temporal trends and geographic variation of lower-extremity amputation in patients with peripheral artery disease: results from US Medicare 2000-2008. *J Am Coll Cardiol*. 2012;60:2230–2236.

106. Potluir VK, Patel SG, Bilello JL, Gill GS, Saleem A, Bagherpour AN. The geographic distribution of interventional radiologists in the United States: a county-level analysis. *Imaging Interv*. 2022;2(1):1–4.

107. Byskosh N, Pamulapati V, Xu S, et al. Identifying gaps in disease knowledge among patients with peripheral artery disease. *J Vasc Surg*. 2022;75:1358–1368.e5.

108. Hirsch AT, Murphy TP, Lovell MB, et al. Gaps in public knowledge of peripheral arterial disease: the first national PAD public awareness survey. *Circulation*. 2007;116:2086–2094.

109. McDermott MM, Hahn EA, Greenland P, et al. Atherosclerotic risk factor reduction in peripheral artery disease: results of a national physician survey. *J Gen Intern Med*. 2002;17:895–904.

110. American Heart Association. Peripheral Artery Disease (PAD) National Action Plan. Accessed August 27, 2023. https://www.heart.org/en/health-topics/peripheral-artery-disease/pad-resources/pad-action-plan

111. White Solaru KT, Coy T, DeLozier S, et al. Findings of a novel barbershop-based peripheral artery disease screening program for Black men. *J Am Heart Assoc*. 2022;11:e026347.

112. Powell-Wiley TM, Baumer Y, Baah FO, et al. Social determinants of cardiovascular disease. *Circ Res*. 2002;130:782–799.

113. He J, Bundy JD, Geng S, et al. Social, behavioral, and metabolic risk factors and racial disparities in cardiovascular disease mortality in U.S. adults: an observational study. *Ann Intern Med*. 2023;176(9):1200–1208.

114. Garrett BE, Martell BN, Caraballa RS, King BA. Socioeconomic differences in cigarette smoking among sociodemographic groups. *Prev Chron Dis*. 2109;16:180553.

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