

Peripheral artery disease among Indigenous Canadians: What do we know?

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Indigenous Canadians experience a disproportionate burden of chronic atherosclerotic diseases, including peripheral artery disease (PAD). Despite an estimated prevalence of 800 000 patients with PAD in Canada, the burden of the disease among Indigenous Canadians is unclear. Available evidence suggests that this population has a higher prevalence of several major risk factors associated with PAD (diabetes, smoking and kidney disease). Unique socioeconomic, geographic and systemic obstacles affecting Indigenous Canadians' health and health care access may worsen chronic disease outcomes. Little is known about the cardiovascular and limb outcomes of Indigenous peoples with PAD. A novel approach via multidisciplinary vascular health teams engaging Indigenous communities in a culturally competent manner may potentially provide optimal vascular care to this population. Further research into the prevalence and outcomes of PAD among Indigenous Canadians is necessary to define the problem and allow development of more effective initiatives to alleviate the disease burden in this marginalized group.

Au Canada, les membres des communautés autochtones sont affectés de manière disproportionnée par les maladies athéroscléreuses chroniques, y compris par l'artériopathie périphérique (AP). Malgré une prévalence estimée de 800 000 patients atteints d'AP au Canada, on ignore quel est le fardeau de la maladie chez les membres des communautés autochtones. Selon les données accessibles, cette population présente une prévalence plus élevée de plusieurs facteurs de risque majeurs associé à l'AP (diabète, tabagisme et maladie rénale). Certains obstacles socioéconomiques, géographiques et systémiques particuliers nuisent aussi à leur santé et leur compliquent l'accès aux soins de santé, ce qui pourrait aggraver les répercussions des maladies chroniques. On en sait peu sur l'issue des problèmes cardiovasculaires et circulatoires périphériques chez les membres des communautés autochtones touchés par l'AP. Une approche nouvelle, impliquant les communautés concernées et offerte de manière culturellement compétente par des équipes de santé vasculaire multidisciplinaires, serait propice à la prestation de soins vasculaires optimaux. Il faudra approfondir la recherche sur la prévalence et l'issue de l'AP chez les membres des communautés autochtones pour cerner le problème et permettre la mise en place d'initiatives plus efficaces afin d'alléger le fardeau de la maladie dans ce groupe marginalisé.

Peripheral artery disease (PAD) refers to atherosclerotic narrowing of the noncardiac, noncranial peripheral arteries. It affects more than 200 million people worldwide and is associated with substantial cardiovascular morbidity, mortality and disability due to limb loss.^{1,2} Modifiable risk factors for PAD include smoking, obesity, physical inactivity and a diet high in fats or cholesterol; nonmodifiable risk factors generally include advanced age and family history. Diabetes mellitus, hypertension, hyperlipidemia and kidney disease are also significant risk factors for PAD; these may be modifiable with appropriate risk reduction therapies.²⁻⁴ Patients with PAD often exhibit symptoms of atherosclerosis in other vascular beds (cerebrovascular or cardiac disease), and they are at a heightened risk for adverse cardiovascular events, including cardiovascular death, stroke and myocardial infarction.⁵⁻⁷ Peripheral artery disease is often asymptomatic, underdiagnosed and undertreated, thereby risking delayed discovery at an advanced stage with a worse prognosis. Treatment options are governed by the specific anatomy and severity of the disease, with lifestyle changes and risk

factor optimization playing essential roles in patients with asymptomatic disease or intermittent claudication.³ Endovascular revascularization in the form of angioplasty with or without stenting, or surgical revascularization via peripheral bypass and/or endarterectomy are options for those with advanced PAD (critical limb ischemia) or those whose condition fails to improve with medical management.⁸

RISK FACTORS AMONG INDIGENOUS CANADIANS

Minority groups experience a disproportionate burden of PAD and its associated complications.⁹ There are 3 constitutionally recognized Indigenous populations in Canada: First Nations, Inuit and Métis. About 1.4 million people self-identify as Indigenous, equating to 4.3% of the Canadian population.¹⁰ Compared to the general population, Canada's Indigenous peoples have a higher prevalence of several major PAD risk factors, including diabetes, hypertension, smoking and chronic kidney disease.^{9,11}

Diabetes is a prominent risk factor given its high prevalence among Canada's Indigenous populations.¹² Age-standardized rates of diabetes of up to 17.2% and 10.3% among First Nations people living on- and off-reserve, respectively, have been reported, and Métis exhibit a rate of 7.3%.¹³ In contrast, age-standardized prevalence in the general Canadian population is considerably lower, at 5%.¹³ Diabetes prevalence in Inuit populations is similar to or lower than that in the general population. The reason for this observation is unclear but may relate to the traditional Inuit diet and lifestyle.¹³ Furthermore, PAD is more likely to develop in Indigenous people with diabetes than in non-Indigenous people with diabetes, and the former also experience an increased burden of other diabetic complications, including hypertension, microvascular damage, diabetic foot, diabetic nephropathy and peripheral neuropathy.^{13,14}

Kidney disease is another important risk factor for Indigenous Canadians. According to a recent cross-sectional analysis of 1346 Indigenous adults across 11 Manitoba communities, the prevalence of chronic kidney disease was 25.5%.¹⁵ Furthermore, Indigenous populations in Canada experience an increased burden of advanced chronic kidney disease (twofold higher prevalence than among the general population), and they are at

77% greater risk for death than non-Indigenous people.^{15,16} Indigenous Canadians may also be at greater risk for progression from chronic to end-stage renal disease, with one estimate suggesting that those with diabetes and hypertension have a risk 7 times greater than that for non-Indigenous persons with the same conditions.¹⁷ Furthermore, First Nations people in Canada without diabetes are 2 to 3 times more likely than non-First Nations people to eventually experience kidney disease.¹⁸ The combination of diabetes and kidney disease is particularly troubling. McIntyre and colleagues¹⁹ observed significantly higher rates of prior foot infection (37% v. 11%) and amputation (36% v. 17%) among Aboriginal Canadians with diabetes and end-stage renal disease than among non-Aboriginal Canadians. Given the disproportionate burden of severe chronic kidney disease, end-stage renal disease and diabetes among Indigenous populations, it is likely that many Indigenous peoples are at high risk for PAD-related cardiovascular and limb complications.

Smoking and hypertension are 2 significant risk factors for PAD, and both are highly prevalent among Indigenous Canadians. Bruce and colleagues¹¹ found significantly higher adjusted odds ratios (ORs) for daily smoking among First Nations (OR 2.09, 95% confidence interval [CI] 1.58–3.04), Métis (OR 1.54, 95% CI 1.07–2.21) and Inuit (OR 3.48, 95% CI 2.43–4.98) peoples compared to the general population. Smoking is a major risk factor for PAD, with heavy smokers (≥ 25 cigarettes/day) experiencing a sevenfold greater risk for the disease.¹⁴ Bruce and colleagues¹¹ also reported numerically higher adjusted ORs for hypertension among First Nations (OR 1.12, 95% CI 0.74–1.69) and Métis (OR 1.22, 95% CI 0.68–2.21) peoples compared to non-Aboriginal people. The prevalence of PAD-related risk factors among Indigenous and non-Indigenous Canadians is presented in Table 1.

There is increasing evidence suggesting that, in addition to these traditional modifiable and nonmodifiable risk factors, Indigenous peoples tend to mount predominantly a type 2 T helper cell immunological response to viruses and other threats, whereas white people mount predominantly a type 1 T helper cell response.^{20–22} Given that atherosclerosis is a chronic inflammatory disease, these differences in immune response may have important implications for diagnosis, progression and treatment of atherosclerosis in Indigenous peoples.

Table 1. Prevalence of risk factors for peripheral artery disease among Indigenous Canadians¹¹

Population	Risk factor; prevalence, %				
	Diabetes	Hypertension	Smoking	Obesity	Inactivity
First Nations	5.22	13.45	45.13	23.55	44.62
Métis	5.67	12.88	33.07	28.28	42.92
Inuit	1.02	7.76	63.62	24.27	52.48
Non-Indigenous	4.10	12.82	22.84	21.05	34.65

BURDEN OF PERIPHERAL ARTERY DISEASE AMONG INDIGENOUS CANADIANS

Owing to a paucity of data, the burden of PAD in the Indigenous Canadian population has not been clearly established. It is reported that as many as 800 000 Canadians have PAD, and, given that the disease is often underdiagnosed, the true number is likely substantially higher.^{2,23} We could not identify any study assessing the overall prevalence of PAD in the Indigenous population in Canada; however, a study of 230 James Bay Cree in Quebec showed the rate to be 14.4% in this community.²⁴ More recently, the prevalence of PAD was documented in studies of diabetic cohorts, although little information was given on the characteristics and severity of the disease. In a 2011 study of Indigenous Canadians, the prevalence of PAD among patients with diabetes ranged from 0% to 13.7% across 19 communities.²⁵ A 2005 study from Sandy Lake, Ontario showed a prevalence of 14.9% among Indigenous patients with diabetes,²⁶ lower than the rate of 41% reported in a northern Manitoba community.²⁷ Therefore, the burden of PAD among the Indigenous population is yet to be clearly defined, given variable observations from heterogeneous study populations and differences in how the disease was defined in these studies.

COMPLICATIONS OF PERIPHERAL ARTERY DISEASE AMONG INDIGENOUS CANADIANS

The most significant complications of PAD include cardiovascular death, myocardial infarction, stroke, critical limb ischemia (rest pain, night pain, ulceration and gangrene) and lower limb amputation. Data on the rates of these complications are remarkably scarce; to our knowledge, no studies have comprehensively examined the outcomes of PAD in the Indigenous population. Studies of diabetes offer some insight into the vascular complications experienced by this population; however, since diabetes confers a significant cardiovascular risk in addition to that associated with PAD, results from these studies likely represent only the patients at highest risk rather than the overall Canadian Indigenous population.

One area that has received some focus in the context of research into Canadian Indigenous vascular health is lower limb complications. Indigenous populations experience a greater burden of foot complications than non-Indigenous populations. In a study of patients with diabetes who had end-stage renal disease, 75% of Indigenous participants had a history of prior foot ulcer, compared to 41% of non-Indigenous participants.¹⁹ Lack of patient education, surveillance and adequate foot care resources among the Indigenous communities may account for this disparity.¹⁹ Furthermore, rural residence is a major risk factor for adverse outcomes in patients with diabetic foot

ulcers, and Indigenous peoples are more likely to reside in rural areas than non-Indigenous peoples.^{27,28}

Amputation is a devastating complication of PAD, from both a health and a quality of life perspective. Indigenous peoples are at significantly higher risk for limb amputation compared to the general public. This is partly due to the increased rates of diabetes and end-stage renal disease among Indigenous peoples. Rose and colleagues²⁹ found that, compared to non-Indigenous patients, Indigenous patients with diabetic foot ulcers progressed to major lower extremity amputation 12 weeks faster. Those living in a rural community or on a First Nations reserve also had a shorter average time to amputation, by 21 weeks, compared to those living in urban locations. Almost one-quarter (24%) of Indigenous patients experienced amputation, compared to 15% of non-Indigenous patients. McIntyre and colleagues¹⁹ reported that the prevalence of lower extremity amputation was up to 16 times higher among Indigenous patients with PAD than among non-Indigenous patients with the disease in Manitoba, and another study showed the overall prevalence of lower extremity amputation to be 36.1% among First Nations people and Métis in Manitoba.²⁷ Therefore, it appears that Indigenous populations are at higher risk for adverse lower limb events owing to a combination of factors, including a higher prevalence of PAD-associated risk factors and inadequate access to important health care resources.

REVASCULARIZATION

Revascularization (endovascular or surgical) is the usual treatment for advanced PAD. Indigenous people undergoing arterial bypass for PAD tend to experience worse outcomes in terms of limb salvage, graft patency and survival owing to more advanced presentation of PAD and a greater prevalence of renal disease.⁹ Indigenous people also require urgent or emergency revascularization more frequently than the non-Indigenous population.⁹ Presentation of more advanced disease may be related to earlier age at onset or to infrequent use of health care services. In a retrospective analysis of patients undergoing revascularization for PAD at a tertiary care centre in Winnipeg, Goulet and colleagues⁹ found that Indigenous patients were an average of 6 years younger than non-Indigenous patients, and significantly fewer experienced symptoms of claudication and pain at rest. Delayed diagnosis is a well-known problem with PAD and is of even greater concern in a population with inadequate surveillance and limited contact with health care professionals.

UNIQUE HEALTH BARRIERS FACED BY INDIGENOUS CANADIANS

One of the largest challenges in addressing the burden of PAD among Indigenous Canadians is the unique mix

of socioeconomic determinants of health and systemic obstacles they experience. For this group, low employment and education, remote living conditions, restricted diet owing to environmental and economic factors, lifestyle limitations, social marginalization owing to Canada's colonizing history, inadequate disease surveillance and poor access to health care resources lead to suboptimal treatment and poor outcomes.^{30,31} These factors produce significant disparities in many areas of health. In a 2003 study, Shah and colleagues³² compared access and quality of health care for Indigenous Ontarians to those for 2 control groups, 1 matched for geographic isolation and the other for socioeconomic status. Compared to the general population, the hospital admission rate for ambulatory-care-sensitive conditions was 2.54, 1.50 and 1.14, respectively. The rate of referral for care-sensitive procedures was 0.64, 0.91 and 1.00, respectively.³² This indicates a greater level of difficulty in obtaining care and suggests that Indigenous patients may also be less likely to receive necessary specialized procedures.

Studies of individual conditions offer further insight, revealing more specific disparities in the care Indigenous patients receive compared to their non-Indigenous counterparts. For example, a study involving more than 147 000 people with diabetes (including more than 6500 First Nations people) showed that, among those without chronic kidney disease, First Nations people were less likely to receive measurement of the urine albumin/creatinine ratio, fasting low-density lipoprotein cholesterol level and glycated hemoglobin concentration (OR 0.79, 0.61 and 0.69, respectively) compared to non-First Nations people.³³ A 2008 study of chronic kidney disease showed that hospital admission for ambulatory-care-sensitive conditions was twofold higher for Indigenous people and that Indigenous patients with chronic kidney disease were 43% less likely than their non-Indigenous counterparts to visit a nephrologist.³⁴ This further suggests difficulties in obtaining initial and specialist care. Clearly, important health care difficulties persist for Indigenous populations, although the full extent of these disparities remains difficult to assess without more complete, national-level data.

UNANSWERED QUESTIONS

A startling number of unanswered questions remain regarding Indigenous Canadians' vascular health. There is low-quality evidence to suggest that this population faces an elevated risk for vascular disease, but key data on PAD prevalence are lacking. The rates of cardiovascular and limb complications experienced by this group are also largely unknown, as is the timeliness, effectiveness and quality of vascular care available to Indigenous populations. National-level data are scarce, and studies

of isolated communities or small populations rarely offer a comprehensive look at vascular health. Indirect data drawn from studies of other cohorts (such as patients with diabetes) are insufficient to ground effective interventions. An urgent need exists for improved PAD awareness, surveillance and management in this population.

CALL TO ACTION: THE NEED FOR A NOVEL APPROACH TO VASCULAR HEALTH AMONG INDIGENOUS CANADIANS

Considering the array of health care barriers Indigenous Canadians face, a disease like PAD — often asymptomatic and underdiagnosed, and requiring long-term management and surveillance — poses a particularly difficult challenge. Yet, given the impact PAD has on both quality of life and life expectancy, this is obviously a vital area to understand. An important gap in public and physician awareness exists for PAD compared to other cardiovascular conditions, and, although informational initiatives have been recommended as one way to bridge this knowledge gap, special considerations must be made if a novel approach targeted toward PAD education, diagnosis, risk reduction and treatment is to be effective for Indigenous Canadians.^{23,35-37}

Recent literature has identified a need for proactive models of chronic disease management,³¹ and some of the principles and strategies developed for other chronic conditions can be applied to PAD. Research methods entailing community-based participatory action and community involvement have been identified as essential components of successful chronic health interventions.³⁸ One current example, the FORGE AHEAD (Transformation of Indigenous Primary Healthcare Delivery) program, aims to develop and assess the effectiveness of several quality-improvement initiatives for chronic disease care in 11 First Nations communities across Canada, with the hope of developing culturally relevant innovations and improving access to care.³¹ Strategies include involving community members as leaders of community-level program components, and creating a community-driven diabetes registry and surveillance system. These approaches can also be applied to PAD, potentially improving care via community-level innovation. Physicians must also be targeted, as there is inadequate awareness of PAD among health care professionals.^{39,40} These awareness initiatives must go beyond medical information and address the social, historical and political factors affecting Indigenous Canadians, facilitating culturally appropriate care.^{31,38} Such understanding has been recognized as a vital step in calls to action of the Truth and Reconciliation Commission of Canada (numbers 23 and 24).⁴¹

A 2015 systematic review identified 5 key areas of consideration for primary health care interventions targeting

chronic diseases among Indigenous populations: design, workforce, patient/provider partnerships, clinical care pathways and access.³⁵ To that end, a meaningful population-based intervention focused on vascular health is needed to specifically target the Indigenous population that is built on these key principles. Multidisciplinary vascular care teams with primary care physicians, nurse practitioners, chiropractors, physiotherapists and social workers that focus on providing holistic vascular care to Indigenous patients with atherosclerotic diseases (PAD, coronary disease, cerebrovascular disease and renovascular disease) have the potential to achieve optimal cardiovascular and limb outcomes. Of course, this team is optimized by the voices and support of community leaders, patients and their families. Furthermore, multidisciplinary teams led by nonphysician allied health care professionals such as chiropractors have shown promise in reducing PAD-related complications, including diabetic foot ulcer and amputation.⁴² However, credible prospective data supporting this approach are currently lacking. Therefore, well-designed randomized clinical trials are required to test whether such an approach can be effective in reducing adverse cardiovascular and limb outcomes in patients with PAD at high risk, improve quality of life and reduce health care costs.

Furthermore, multidisciplinary teams should also receive cultural safety and humility training to build effective, empowering partnerships with Indigenous patients.⁴³ Regardless of location in Canada, health care providers and their patients should have access to key resources including established referral pathways to specialists such as vascular surgeons, cardiologists and endocrinologists. Most important, such a strategy should promote community engagement and involve Indigenous health care workers in decision-making. Convolved referral pathways and inefficient support systems should be avoided, and services must be consistent and well coordinated to provide optimal access to care. Such a program would also offer essential information on the little-known area of Indigenous vascular health and wellness.

CONCLUSION

Further studies are needed, both to clarify the overall burden of PAD among Indigenous Canadians and to measure the complications and outcomes they experience as a result. Although PAD itself is poorly defined in this population, recent research has shed light on several major risk factors (smoking, diabetes and renal disease), and current inequities in these areas suggest that a disproportionate burden of PAD likely affects Indigenous Canadians. The difficulties and uncertainties associated with Indigenous health research often arise for many of the same reasons that health inequities persist in the first

place — namely, a lack of health care access and surveillance, and a subsequent dearth of relevant information. Thus, further research in this area will not only contribute to an improved understanding of Indigenous health but will also be critical in producing a research and policy landscape conducive to effective, focused public health interventions with Indigenous leaders, health care providers and patients holding vital partnership roles in this process.

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