
When the Calculator Is Biased: Rethinking Cardiometabolic Risk Assessment in Indigenous Health

Aishwarya Rajesh Krishnan¹

¹ Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada

Correspondence: a.rajeshkrishnan@mail.utoronto.ca

Date Published: April 30, 2026

DOI: <https://doi.org/10.18192/UOJM.V16iS1.7817>

Cardiometabolic disease prevalence is increasing globally, especially as the obesity epidemic continues to rise.¹ Cardiovascular issues and other related conditions are the leading cause of death worldwide.² As clinicians, when we assess our patients for their cardiometabolic risk, we review their cardiometabolic risk score using their lab values and demographics, and derive the most effective treatment intervention based on the most likely outcomes.^{3,4} Our system has taught us to rely on objective metrics and tools to inform us of our decisions, and as long as it is objective, no undue harm has been inflicted, right?

Unfortunately, not. Many of the widespread cardiometabolic tools employed in day-to-day practice, including Framingham risk scores, Atherosclerotic Cardiovascular Disease (ASCVD) risk equations, or even the new 2023 Predicting Risk of Cardiovascular Disease EVENTS (PREVENT) equations, were generated to standardize clinical practice, yet cardiometabolic risk is not culturally neutral.⁵⁻⁹ For many Indigenous populations in Canada, cardiometabolic risk is shaped by structural determinants, and with uncritical use of Westernized tools, we risk perpetuating the very disparities they aim to prevent.⁹

Cardiometabolic risk assessment holds a crucial role in preventative medicine. Standardized tools, including the Framingham risk scores, ASCVD risk equations, and PREVENT equations, often derive their results from standardized variables such as age, sex, blood pressure, lipid levels, and diabetes and smoking status.⁵⁻⁸ While these tools aim to provide objectivity, these equations have been derived from predominantly White, urban, and middle-high income individuals.⁵

The application of cardiometabolic risk scores in Indigenous populations is of concern.^{10,11} Many of these tools have not included Indigenous peoples in their study cohort, limiting generalizability.⁵ These tools do not consider the social implications of the metrics they include in their formula. For instance, BMI may not capture cardiometabolic risk across populations with varying body composition, nutritional environments, and food insecurity histories.⁹⁻¹¹ HbA1c levels may also be influenced by anemia, chronic stress, and inconsistent access to care, which are factors that often disproportionately affect Indigenous communities, thereby introducing systematic bias into glycemic risk estimation.¹²⁻¹⁶

Standard cardiometabolic risk calculators implicitly assume regular access to follow-up, pharmacotherapy, and other downstream interventions.⁶⁻⁸ However, many diverse Indigenous communities reside in rural and remote communities. These tools fail to account for these contexts, which could underestimate true cardiovascular risk.^{17,18} Underestimation may occur because existing models do not incorporate structural determinants such as chronic stress from systemic racism, food insecurity, or barriers to care continuity, all of which can influence cardiometabolic physiology.^{12-14,16} Conversely, overestimation may arise when rigid thresholds derived from non-representative populations are applied to Indigenous communities without contextual calibration, potentially pathologizing populations without corresponding access to preventive interventions or culturally appropriate care pathways.¹⁹ Regardless, misclassification can delay appropriate care and reinforce deficit-based narratives.¹⁸⁻²¹

When we use cardiometabolic risk calculators uncritically

in Indigenous populations, we risk undermining informed decision-making. This can be expanded into the broader concept of ethical tensions observed in cross-cultural care.²² Indigenous scholars highlight the value of relational and collective health decision-making, rather than individualistic and rigid approaches to care.^{23,24} Applying these thresholds without frontline engagement with Indigenous communities risks silencing Indigenous knowledge systems.^{25–27}

Cardiometabolic risk assessment reflects deeper colonial assumptions nested in biomedical knowledge. Western medicine embodies a linear trajectory.²⁸ In comparison, Indigenous conceptions of health and disease are centred upon relationships to land and community with intergenerational well-being.²⁹ Thus, the prevailing use of cardiometabolic risk frameworks is almost a continuation of colonial patterns which privilege certain forms of knowledge while dismissing others.^{30,31}

Nonetheless, we should not reject cardiometabolic risk tools altogether, as it is important to recognize biomedical science development within historical and social contexts. It is when we divorce from those contexts and apply their principles universally that we begin to reproduce inequities. When we define cardiometabolic risk without Indigenous governance, it is another form of epistemic and data extraction, of data interpreted or taken without accountability to the communities which are most affected.^{32–34} This includes the extraction of interpretive authority and decision-making power, reinforcing existing inequities in knowledge production and application.

Therefore, addressing these challenges requires a change in direction from uncritical adoption to collaborative redesign of cardiometabolic risk assessment. Indigenous-governed research partnerships are crucial for risk model validation^{34–36} These outcomes should include quality of life, functional capacity, and continuity of care.^{37,38} Better flexible thresholds will enable improved accuracy of clinical judgement and patient values.^{5,20,36–38} Importantly, these partnerships should produce tangible outputs, including community-calibrated risk equations, co-developed clinical guidelines, and decision-support tools that integrate both biomedical and social determinants of health.

Adherence to Indigenous data sovereignty is equally important, including adopting the Ownership, Control, Access, and Possession (OCAP) framework.³⁹ Risk models

should be generated and implemented in a method to ensure continuity of community governance over data collection and interpretation.³⁹ By integrating social determinants into risk assessments, we could align preventative care with the realities of Indigenous health.^{19,20,24,38}

One approach is the incorporation of structured variables, including food insecurity status, housing instability, or access to primary care, into existing prediction models as modifiers or stratification factors.^{38,40} For example, risk calculators could include adjustment coefficients for patients experiencing food insecurity or limited healthcare access, similar to how socioeconomic indices have been incorporated into public health risk models.^{3,6,37} Additionally, community-specific calibration of risk thresholds could better align predicted risk with observed outcomes.⁴⁰ Finally, risk assessment could be embedded within community-led care models where clinicians interpret risk scores alongside Indigenous health workers.⁴⁰

In conclusion, cardiometabolic risk calculators are not without their biases.^{5–8} For Indigenous peoples, widespread use of these standardized frameworks without adaptation exacerbates health disparities under the guise of objectivity.^{40,41} Reframing risk as a culturally situated and ethically charged construct allows us to realize the fundamental question: who defines risk, and who bears the consequences when it is wrong? Centring Indigenous leadership, valuing diverse knowledge systems, and embracing structural accountability move cardiometabolic prevention closer to its stated goal: improving health outcomes for all, rather than reinforcing the divides of the past.^{38–41}

REFERENCES

1. Valenzuela PL, Carrera-Bastos P, Castillo-García A, Lieberman DE, Santos-Lozano A, Lucia A. Obesity and the risk of cardiometabolic diseases. *Nat Rev Cardiol.* 2023 Jul 1;20(7):475–94. doi:10.1038/S41569-023-00847-5 PubMed PMID: 36927772.
2. Di Cesare M, McGhie DV, Perel P, Mwangi J, Taylor S, Pervan B, et al. The Heart of the World. *Glob Heart.* 2024;19(1):11. doi:10.5334/GH.1288 PubMed PMID: 38273998.
3. Gurka MJ, Filipp SL, Pearson TA, Deboer MD. Assessing Baseline and Temporal Changes in Cardiometabolic Risk Using Metabolic Syndrome Severity and Common Risk Scores. *Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease.* 2018 Aug 1;7(16):e009754. doi:10.1161/JAHA.118.009754 PubMed PMID: 30369320.
4. Shen T, Zhao M, Qiao S, Yang Z, Li M, Zhao M, et al.

- Management of cardiometabolic risk factors in cardiovascular high-risk populations with varying cognitive levels. *Aging Clin Exp Res.* 2025 Dec 1;38(1):8. doi:10.1007/S40520-025-03241-Y PubMed PMID: 41460429.
5. Wilson PWF, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation.* 1998 May 12;97(18):1837–47. doi:10.1161/01.CIR.97.18.1837 PubMed PMID: 9603539.
 6. Mahmood SS, Levy D, Vasan RS, Wang TJ. The Framingham Heart Study and the Epidemiology of Cardiovascular Diseases: A Historical Perspective. *Lancet.* 2013;383(9921):999. doi:10.1016/S0140-6736(13)61752-3 PubMed PMID: 24084292.
 7. Anderson TS, Wilson LM, Sussman JB. Atherosclerotic Cardiovascular Disease Risk Estimates Using the Predicting Risk of Cardiovascular Disease Events Equations. *JAMA Intern Med.* 2024 Aug 5;184(8):963. doi:10.1001/JAMAINTERNMED.2024.1302 PubMed PMID: 38856978.
 8. Abdul Jabbar A Bin, Inam M, Butt N, Khan SS, Sheikh S, Khoja A, et al. Predicting Risk of Cardiovascular Disease EVENTS (PREVENT) Equations: What Clinicians Need to Know? *Curr Atheroscler Rep.* 2025 Dec 1;27(1). doi:10.1007/S11883-025-01320-Z PubMed PMID: 40690117.
 9. Tanasescu MD, Rosu AM, Minca A, Rosu AL, Grigorie MM, Timofte D, et al. Beyond BMI: Rethinking Obesity Metrics and Cardiovascular Risk in the Era of Precision Medicine. *Diagnosics.* 2025 Dec 1;15(23):3025. doi:10.3390/DIAGNOSTICS15233025 PubMed PMID: 41374408.
 10. Te Vazquez J, Feng SN, Orr CJ, Berkowitz SA. Food Insecurity and Cardiometabolic Conditions: a Review of Recent Research. *Curr Nutr Rep.* 2021 Dec 1;10(4):243. doi:10.1007/S13668-021-00364-2 PubMed PMID: 34152581.
 11. Miguel E da S, Lopes SO, Araújo SP, Priore SE, Alfenas R de CG, Hermsdorff HHM. Association between food insecurity and cardiometabolic risk in adults and the elderly: A systematic review. *J Glob Health.* 2020 Dec 1;10(2):020402. doi:10.7189/JOGH.10.020402 PubMed PMID: 33110569.
 12. Katwal PC, Jirjees S, Htun ZM, Aldawudi I, Khan S. The Effect of Anemia and the Goal of Optimal HbA1c Control in Diabetes and Non-Diabetes. *Cureus.* 2020 Jun 4;12(6):e8431. doi:10.7759/CUREUS.8431 PubMed PMID: 32642346.
 13. Christy AL, Manjrekar PA, Babu RP, Hegde A, Rukmini MS. Influence of Iron Deficiency Anemia on Hemoglobin A1C Levels in Diabetic Individuals with Controlled Plasma Glucose Levels. *Iran Biomed J.* 2014;18(2):88. doi:10.6091/IBJ.1257.2014 PubMed PMID: 24518549.
 14. Walker RJ, Garacci E, Campbell JA, Egede LE. The Influence of Daily Stress on Glycemic Control and Mortality in Adults with Diabetes. *J Behav Med.* 2019 Oct 1;43(5):723. doi:10.1007/S10865-019-00109-1 PubMed PMID: 31617047.
 15. Pérez-Fernández A, Fernández-Berrocal P, Gutiérrez-Cobo MJ. The relationship between well-being and HbA1c in adults with type 1 diabetes: A systematic review. *J Diabetes.* 2023 Feb 1;15(2):152. doi:10.1111/1753-0407.13357 PubMed PMID: 36796311.
 16. Schultz A, Nguyen T, Sinclair M, Fransoo R, McGibbon E. Historical and Continued Colonial Impacts on Heart Health of Indigenous Peoples in Canada: What's Reconciliation Got to Do With It? *CJC Open.* 2021 Dec 1;3(12 Suppl):S149. doi:10.1016/J.CJCO.2021.09.010 PubMed PMID: 34993444.
 17. Vervoort D, Kimmaliardjuk DM, Ross HJ, Fremes SE, Ouzounian M, Mashford-Pringle A. Access to Cardiovascular Care for Indigenous Peoples in Canada: A Rapid Review. *CJC Open.* 2022 Sep 1;4(9):782. doi:10.1016/J.CJCO.2022.05.010 PubMed PMID: 36148252.
 18. Lucero AA, Lambrick DM, Faulkner JA, Fryer S, Tarrant MA, Poudevigne M, et al. Modifiable Cardiovascular Disease Risk Factors among Indigenous Populations. *Adv Prev Med.* 2014;2014:547018. doi:10.1155/2014/547018 PubMed PMID: 24649368.
 19. Clarke-Grant D. Healthcare Access for Indigenous Communities in Rural Canada: A Narrative Review and Interdisciplinary Framework for Action. *Intergovernmental Research and Policy Journal.* 2025 Jun 29. doi:10.24095/HPCDP.44.4.01 PubMed PMID: 38597804.
 20. Stanley LR, Swaim RC, Kaholokula JK, Kelly KJ, Belcourt A, Allen J. The Imperative for Research to Promote Health Equity in Indigenous Communities. *Prev Sci.* 2020 Jan 1;21(Suppl 1):13. doi:10.1007/S11121-017-0850-9 PubMed PMID: 29110278.
 21. Bullen J, Hill-Wall T, Anderson K, Brown A, Bracknell C, Newnham EA, et al. From Deficit to Strength-Based Aboriginal Health Research—Moving toward Flourishing. *Int J Environ Res Public Health.* 2023 Apr 1;20(7):5395. doi:10.3390/IJERPH20075395 PubMed PMID: 37048008.
 22. Howard M, Tan KL, Jayasekara R. Exploring Ethical, Cultural, and Transnational Competence Among International Healthcare Management Students: An Australian Perspective. *J Healthc Leadersh.* 2025;17:97. doi:10.2147/JHL.S506361 PubMed PMID: 40093562.
 23. Neill A, Montesanti S, Bill L, Verstraeten BSE, Bell RC, Oster RT, et al. Aligning Indigenous and Western Concepts of Health Resource Decision Making in a Western Canadian First Nations Context. *Appl Health Econ Health Policy.* 2025 Jan 1;24(1):163. doi:10.1007/S40258-025-01004-4 PubMed PMID: 40975841.
 24. Quelch J, Aden M, Toombs E, Sanders C, Sinoway C, Mushquash C, et al. Understanding the circle of care: Indigenous service providers' perspectives on health and well-being. *AlterNative: An International Journal of Indigenous Peoples.* 2025 Mar 1;21(1):3–10. doi:10.1177/11771801251319274
 25. Nguyen NH, Subhan FB, Williams K, Chan CB. Barriers and Mitigating Strategies to Healthcare Access in Indigenous Communities of Canada: A Narrative Review. *Healthcare.* 2020 Jun 1;8(2):112. doi:10.3390/HEALTHCARE8020112 PubMed PMID: 32357396.
 26. Billan J, Starblanket D, Anderson S, Legare M, Hagel MC, Oakes N, et al. Ethical research engagement with Indigenous communities. *J Rehabil Assist Technol Eng.* 2020 Jan;7:2055668320922706. doi:10.1177/2055668320922706 PubMed PMID: 32612848.
 27. Kennedy A, Sehgal A, Szabo J, McGowan K, Lindstrom G, Roach P, et al. Indigenous strengths-based approaches to healthcare and health professions education – Recognising the value of Elders' teachings. *Health Educ J.* 2022 Jun 1;81(4):423. doi:10.1177/00178969221088921 PubMed PMID: 35531386.
 28. Mir A El, Sousa EB de, Mesina-Estarrón I, Celi LA, Hani M, Benjelloun M, et al. Moving beyond the empty cell: The threat of decontextualized healthcare data. *PLOS Digital Health.* 2026 Jan 13;5(1):e0001194. doi:10.1371/JOURNAL.PDIG.0001194 PubMed PMID: 41528993.
 29. Biles BJ, Serova N, Stanbrook G, Brady B, Kingsley J, Topp SM, et al. What is Indigenous cultural health and wellbeing? A narrative review. *Lancet Reg Health West Pac.* 2024 Nov 1;52:101220. doi:10.1016/J.LANWPC.2024.101220 PubMed PMID: 39664592.
 30. Wispelwey B, Tanous O, Asi Y, Hammoudeh W, Mills D. Because its power remains naturalized: introducing the settler colonial determinants of health. *Front Public Health.* 2023;11:1137428. doi:10.3389/FPUH.2023.1137428 PubMed PMID: 37533522.
 31. Agbonlahor O, DeJarnett N, Hart JL, Bhatnagar A, McLeish AC, Walker KL. Racial/Ethnic Discrimination and Cardiometabolic Diseases: A Systematic Review. *J Racial Ethn Health Disparities.* 2024 Apr 1;11(2):783–807. doi:10.1007/S40615-023-01561-1 PubMed PMID: 36976513.
 32. Anderson M. Indigenous health research and reconciliation. *CMAJ: Canadian Medical Association Journal.* 2019 Aug 26;191(34):E930. doi:10.1503/CMAJ.190989 PubMed PMID: 31451523.
 33. Biles BJ, Serova N, Stanbrook G, Brady B, Kingsley J, Topp SM, et al. What is Indigenous cultural health and wellbeing? A narrative review. *Lancet Reg Health West Pac.* 2024 Nov 1;52:101220. doi:10.1016/J.LANWPC.2024.101220 PubMed PMID: 39664592.

-
-
34. Garba I, Sterling R, Plevel R, Carson W, Cordova-Marks FM, Cummins J, et al. Indigenous Peoples and research: self-determination in research governance. *Front Res Metr Anal.* 2023;8:1272318. doi:10.3389/FRMA.2023.1272318/FULL
 35. Melro CM, Gilfoyle M, Ballantyne C, Augustine L, Brass G, Rabbitskin N, et al. Engaging Indigenous partners in health service transformation: a framework for sustained engagement built on trust. *Res Involv Engagem.* 2025 Dec 1;11(1):47. doi:10.1186/S40900-025-00721-3 PubMed PMID: 40361206.
 36. Wieman N, Malhotra U. “Two eyed seeing”—embracing both Indigenous and western perspectives in healthcare. *The BMJ.* 2023;383:p2614. doi:10.1136/BMJ.P2614 PubMed PMID: 37957017.
 37. Rosolova H, Nussbaumerova B. Cardio-metabolic risk prediction should be superior to cardiovascular risk assessment in primary prevention of cardiovascular diseases. *EPMA J.* 2011 Mar;2(1):15. doi:10.1007/S13167-011-0066-1 PubMed PMID: 23199124.
 38. Marques MDC, Pires R, Perdigão M, Sousa L, Fonseca C, Pinho LG, et al. Patient-Centered Care for Patients with Cardiometabolic Diseases: An Integrative Review. *J Pers Med.* 2021 Dec 1;11(12):1289. doi:10.3390/JPM11121289 PubMed PMID: 34945763.
 39. Mashford-Pringle A, Pavagadhi K. Using OCAP and IQ as Frameworks to Address a History of Trauma in Indigenous Health Research. *AMA J Ethics.* 2020 Oct 1;22(10):E868–73. doi:10.1001/AMAJETHICS.2020.868 PubMed PMID: 33103649.
 40. Sehgal A, Henderson R, Murry A, Crowshoe L, Barnabe C. Advancing health equity for Indigenous peoples in Canada: development of a patient complexity assessment framework. *BMC Primary Care.* 2024 Dec 1;25(1):144. doi:10.1186/S12875-024-02362-Z PubMed PMID: 38684966.
 41. Lafontaine A. Indigenous health disparities: a challenge and an opportunity. *Canadian Journal of Surgery.* 2018 Oct 1;61(5):300. doi:10.1503/CJS.011718 PubMed PMID: 30246975.

Conflicts of Interest Disclosure

There are no conflicts of interest to declare.