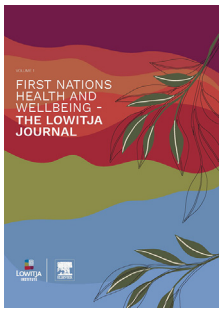

Review

Diabetes-related foot interventions to improve outcomes for Indigenous peoples in high-income countries: A scoping review

Michele Garrett[a,*], *Belinda Ihaka (Te Aupōuri)*[b], *Rinki Murphy*[a], *Timothy Kenealy*[a]

[a]University of Auckland, School of Medicine, Faculty of Medical and Health Sciences, Bldg 507, 28 Park Ave, Grafton, Auckland 0123, New Zealand
[b]AUT University, School of Clinical Sciences, 90 Akoranga Drive, Auckland 0627, New Zealand

Abstract

Purpose Indigenous peoples from high income countries experience health disparities attributable to the ongoing legacy of colonisation and racism, including higher rates of diabetes and associated complications, including diabetes foot disease, in comparison to the relevant resident population. Providing culturally safe care through well-organised diabetes foot interventions can improve outcomes. This scoping review describes the range of publications detailing diabetes foot interventions that incorporated Indigenous peoples.

Methods This scoping review followed the PRISMA-Scoping Review guide. Indigenous Māori perspectives were included in all stages of the review. Eligible publications described diabetes foot interventions that included Indigenous peoples from high-income countries. Key study characteristics included country, Indigenous population, intervention description, foot-related outcomes, and alignment with the CONSIDER statement domains for reporting on Indigenous involvement in health research.

Main findings A total of 32 publications met the eligibility criteria, with publications from Australia (n = 14), Canada (n = 6), USA (n = 6), New Zealand (n = 2), Greenland (n = 2) and Nauru (n = 2). Primary prevention interventions were predominant (n=20) with a focus on increasing foot screening rates (n=16). Other interventions included health promotion and education (n=4), comprehensive foot interventions (n=5), foot care services embedded in undergraduate podiatry education, a diabetic foot ulcer management protocol, and a service brokerage model. Only 2 studies of the 29 evaluated reported all the CONSIDER statement domains.

*Corresponding author.
E-mail address: mgar021@aucklanduni.ac.nz (M. Garrett).

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Principal conclusions Few publications described improved outcomes for Indigenous peoples and most interventions for diabetes-related foot disease overlooked Indigenous perspectives and health beliefs concerning feet. The CONSIDER statement provides useful guidance for all stages of research with Indigenous peoples and our findings suggest reporting Indigenous engagement could be strengthened.

Keywords: Indigenous Peoples; Diabetes Foot Disease; Interventions; CONSIDER statement; Scoping review

Highlights

- Cultural perspectives of feet are often overlooked in diabetes foot interventions.
- Alignment with the CONSIDER Statement domains is lacking.
- Indigenous knowledge needs explicit attention in diabetes foot research.
- Few interventions demonstrated improved outcomes for Indigenous peoples.

Introduction

Type 2 diabetes (T2D) is a long-term health condition affecting a significant and growing proportion of the world population, including Indigenous peoples (Harris et al. 2017). Indigenous peoples number > 370 million in some 90 countries around the world, representing approximately 5% of the world population (Secretariat of the Permanent Forum on Indigenous Issues, 2015; The World Bank, 2021; United Nations-UNDP, 2021). Globally, Indigenous peoples face worse health outcomes than their non-Indigenous counterparts (Secretariat of the Permanent Forum on Indigenous Issues, 2015; Valeggia & Snodgrass, 2015), including higher rates of diabetes. The primary cause of these disparities can be attributed to the ongoing legacy of colonisation and racism (Crowshoe et al. 2018).

Colonisation effectively foregrounds the dominant coloniser worldview, interrupting Indigenous peoples' cultural continuity with land, language, food, wellbeing and tradition, marginalising Indigenous peoples, and limiting socioeconomic status-enhancing opportunities. The legacy of colonisation enables institutional racism and cultural hegemony in societal institutions (Williams & Mohammed, 2013), embedding the more upstream causes, especially the multiple components of access to healthcare and health system responsiveness (Levesque et al. 2013). The responses to upstream drivers also impact collective and individual resilience, modulating behavioural, psychological and physiological responses, which in turn impacts health and health outcomes (Williams & Mohammed, 2013).

The onset of T2D occurs earlier for Indigenous peoples. It brings higher diabetes-related morbidity and mortality than for non-Indigenous peoples (Crowshoe et al. 2018), including more foot-related complications (Blanchette et al. 2023; Crowshoe et al. 2018; Gurney et al. 2018; Isa & Pace, 2021; Robinson et al. 2016; Schoen & Norman, 2014). These may be associated with a higher prevalence of personal risk factors or differences in access to positive social determinants of health that are commonly considered key contributors to the disparities in health outcomes. However, inequities in lower limb outcomes can remain after correcting these risk factors (Gurney et al. 2018; Robinson et al. 2016).

The causal pathway and risk factors predisposing people with T2D to diabetes-related foot disease

(DFD) and amputation are well established (Armstrong et al. 2017; Boulton, 2013; Reiber et al. 1999). This knowledge has informed successful ulcer and amputation prevention strategies based on foot screening, organised foot protection services, management of foot risk factors and early referral to specialist foot services for acute foot problems (Albright et al. 2020; Lazzarini et al. 2015; Leese et al. 2011; NHS Digital, 2018; Paisey et al. 2018). However, inadequate provision or organisation of diabetes-related foot services can restrict access to care, contributing to poorer outcomes for people with DFD (Jeffcoate et al. 2017; Paisey et al. 2018; Robinson et al. 2016). Eurocentric worldviews on health and wellness, institutional racism and culturally unsafe contexts may also be barriers to Indigenous peoples accessing foot services (Browne & Garrett, 2010; Schoen & Norman, 2014). Culturally safe delivery of diabetes prevention and treatment strategies may help to overcome these barriers (Curtis et al. 2019; Gerrard et al. 2021; Tremblay et al. 2020).

How the foot is perceived may also add to the dissonance between Indigenous and non-Indigenous views on foot health and foot care services. For some Indigenous peoples, feet can hold particular significance, having been described as the first sense of the body, physically connecting people to place and land (Garrett, 2016). This challenges the typical Western construct of a five-sense system (sight, smell, hearing, taste and touch). Connection with the land is a significant unifying feature for Indigenous peoples (Durie, 2004).

There is an intention in healthcare research to improve outcomes for Indigenous peoples; however, despite many efforts, research in the diabetes domain highlights persisting health inequities and unequal health outcomes (Harris et al. 2017). It is apparent in healthcare, where it is not what but how we do things that can influence outcomes (Beaton et al. 2019; Crowshoe et al. 2018; Gibson & Segal, 2015). This has led to a call by Indigenous health experts to stop research being 'done on' Indigenous peoples and to promote health research informed by Indigenous health research agendas and worldviews (Reid et al. 2019).

In recent years, ethics requirements in Aotearoa New Zealand and other countries have seen increasing emphasis on protecting Indigenous rights and ensuring an equity focus (Reid et al. 2017). The recently developed CONSolIDated CritERia for Strengthening Reporting of Health Research involving Indigenous Peoples (CONSIDER) statement is a tool designed to enhance reporting (Huria et al. 2019). It combines significant themes from seven previously published ethical guidelines involving Indigenous peoples from high-income countries experiencing colonisation but advocating for decolonised approaches to health research. CONSIDER encompasses eight domains of research: relationships, participation, governance, prioritisation, methodology, analysis and interpretation, and dissemination.

Little is known about diabetes-related foot interventions explicitly designed for Indigenous peoples. A preliminary search of PubMed, Open Science Framework and JBI Evidence Synthesis for diabetes found one systematic review that highlighted the lack of Australian state or national Indigenous diabetes-related foot programs (Chuter et al. 2019). This study wanted to know more about diabetes-related foot interventions that included Indigenous peoples, to understand strategies that have been used. It also wanted to shed light on how the literature reported on DFD interventions involving Indigenous peoples. Despite the recent introduction of the

CONSIDER statement, it was still appropriate to review literature predating its publication. The statement draws on research and ethics guidelines dated 1998 – 2018, demonstrating that the concept of researching 'with' Indigenous peoples is not new. The CONSIDER statement also paralleled the current focus on high-income countries whose Indigenous peoples experience colonisation.

The main objectives of this scoping review were to ascertain the type and range of available evidence detailing diabetes-related foot interventions for Indigenous peoples from high-income countries and their reporting alignment with the CONSIDER statement.

Methods

The team undertaking this review are all located in the Northern Region of Aotearoa New Zealand and between them have collectively worked in healthcare spanning specialist medicine, primary care foot protection services, specialist foot care services and tertiary education for medical and podiatry students. One of the authors is Indigenous Māori and the other three are non-Indigenous. This work has predominately been within mainstream health services, but the authors have each worked with Māori health providers and been involved in research that is Māori centred. The authors acknowledge the views of health and wellness that mainstream services are predicated on, which differ from holistic Indigenous perspectives. To redress some of the biases that could have been brought to this review, advice from the project Māori Governance Group was sought on protocol development and input in the manuscript preparation phase. Additionally, the authors would like to acknowledge that the use of the word 'intervention' stems from a Western research perspective and 'intervention' can evoke traumatic memories of cultural erasure for some Indigenous communities. The term may symbolise a history of colonial practices that controlled and dismantled Indigenous peoples' cultures, languages and way of life.

A scoping review was considered the most suitable review methodology for scoping the coverage of the body of literature and examining research conduct, as there were few existing reviews on the topic (Munn et al. 2018). This review was guided by the five-step scoping review framework initially outlined by Arksey and O'Malley (2005) and reported following The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guideline (Tricco et al. 2018). This involved determining the research question, searching and identifying and selecting the relevant studies, selecting relevant studies, charting and collating the data, and summarising and reporting the results.

Consumer involvement and Indigenous governance

An optional step when undertaking a scoping review is to seek informant input to provide insight into the topic. It was unfeasible to include consumer or patient engagement, as this review sought studies from multiple countries targeting different levels of care. However, as the review focused on foot programs for Indigenous peoples, the authors wanted to include an Indigenous perspective in the review design and implementation. They worked closely with an Indigenous Māori Governance Group, reflecting a partnership approach in the research process with both views represented in the protocol development. In addition to the Group's contribution, BI, a member of the Group, was part of the review process and manuscript development. Research praxis in Aotearoa is moving to this partnership model of governance.

Eligibility criteria

Population: The target population of the service intervention was Indigenous peoples, as described by the United Nations (UN Permanent Forum on Indigenous Issues. Who are indigenous peoples?). If the study population was not predominately Indigenous, studies were included where results were reported by ethnicity, and the effect for Indigenous participants could be identified.

Intervention: It is understood that any activity intended to provide DFD prevention and management services can be conceptualised as an intervention leading to outcomes.

- Studies describing any component of an intervention aimed at preventing DFD, with DFD as defined by the International Working Group on the Diabetic Foot (van Netten et al. 2023).
- Interventions could be standalone foot services or integrated as part of broader diabetes care or other programs. These could include a description or evaluation of an existing or new intervention.
- Diabetic foot disease interventions included primary prevention (foot screening and education), secondary prevention studies (focused on preventing first and subsequent diabetes-related foot ulcer [DFU]), tertiary management (that managed DFUs, Charcot foot and other acute DFD complications) and comprehensive interventions (that spanned more than one level). Studies or reports were included if they clearly described the intervention or referred to a supplementary study that described the intervention. For example, in longitudinal studies, program detail is often described in a previous paper and results or outcomes are reported separately.

Setting: High-income countries, as defined by the World Bank, include countries with an annual Gross National Income per capita of ≥ $12,696 (The World Bank, n.d.).

Comparator: Studies with or without comparator groups were included.

Outcomes: Diabetic foot disease prevention and management to entail multiple processes in steps that can each be regarded as an 'outcome' of a prior process. This could include the result of any diabetes foot service-related process or outcome. For example, the number of foot screens provided, diabetes-related lower extremity amputation (referred to as amputation) rate, number of DFUs, patient or provider knowledge, attitudes or actions (self-reported or otherwise), or the development of educational material.

Study design: All study designs with primary data were included (qualitative, quantitative and mixed methods). Grey literature such as theses were included. Systematic reviews, editorials, opinion pieces, book chapters, conference abstracts and posters were excluded.

Other: There was no time limit on publication dates and no language limitations.

Information sources

A search strategy was developed with the help of a specialist librarian, and searches of the electronic databases MEDLINE, Informit Indigenous collection, CINAHL, PsychINFO, Scopus and Embase were undertaken. The search strategy included terms for DFD, interventions and Indigenous peoples (full details available in Supplementary files). The searches were run on 17 June 2021, searching all databases from inception. The searches were updated on 9 March 2024. Reference lists of all included studies were

examined and any systematic reviews were identified to determine further relevant studies. Checks were also made for any recent publications by the key authors.

Selection of sources of evidence

The titles and abstracts of all identified publications were downloaded to EndNote 20 (The EndNote Team, 2013), where duplicates were removed. The remaining articles were exported to the online review application Rayyan (https://www.rayyan.ai/) (Ouzzani et al. 2016). The title and abstracts of all articles were independently screened against the inclusion criteria by two reviewers, either TK (non-Indigenous) and MG (non-Indigenous) or BI (Indigenous Māori) and MG. The three reviewers discussed discrepancies seeking agreement. If consensus could not be reached, a fourth reviewer (RM, non-Indigenous) was available to adjudicate, but this was not required. The full-text papers for potentially relevant articles were retrieved and uploaded into Rayyan. Two reviewers assessed each article's full text against the eligibility criteria and consensus with BI to verify the inclusion of the selected studies. For the updated search, title and abstract review was undertaken by MG and inclusion of eligible publications were agreed to by all.

Data charting process

Two data extraction forms were used. The first captured publication information including country, Indigenous population, description of the intervention and any provided foot-related outcomes. The second captured the eight domains and the 17 criteria from the CONSIDER reporting guide. TK and MG independently charted the article information, which was then reviewed by all authors. For the CONSIDER reporting guide, articles were independently reviewed by two reviewers (BI and MG). The reviewers discussed any differences between their results to reach a consensus; if necessary, a third reviewer was consulted. This process allowed for interpretation of different terms used to describe certain activities and negotiate a shared understanding of what is reported.

Data items

The following were abstracted from each publication:

Publication characteristics: author, title, journal, year of publication, country in which the intervention took place, and if the intervention was evaluated or described.

Context: Indigenous peoples, participant population, focus of the intervention, whether the foot component was standalone or integrated as part of a diabetes program or other chronic disease program, and the service context. (There was a deviation from the original protocol, as which health discipline led the studies was not included. This was unfeasible because it was found that many studies had multiple disciplines involved and defining a lead discipline would not have added to the review.)

Intervention: details and level (primary, secondary, tertiary comprehensive) of the intervention, details of the foot component, any reported outcome measures if the intervention was evaluated and a summary of the main points.

CONSIDER statement reporting guide: Publications were evaluated against 16 of the 17 reporting guide items; item 12 relating to biological tissue and other samples was not relevant to the publications sought in this review.

Synthesis of results

Included studies were described and summarised in tabular form, in terms of findings, context and the CONSIDER statement, followed by a narrative report.

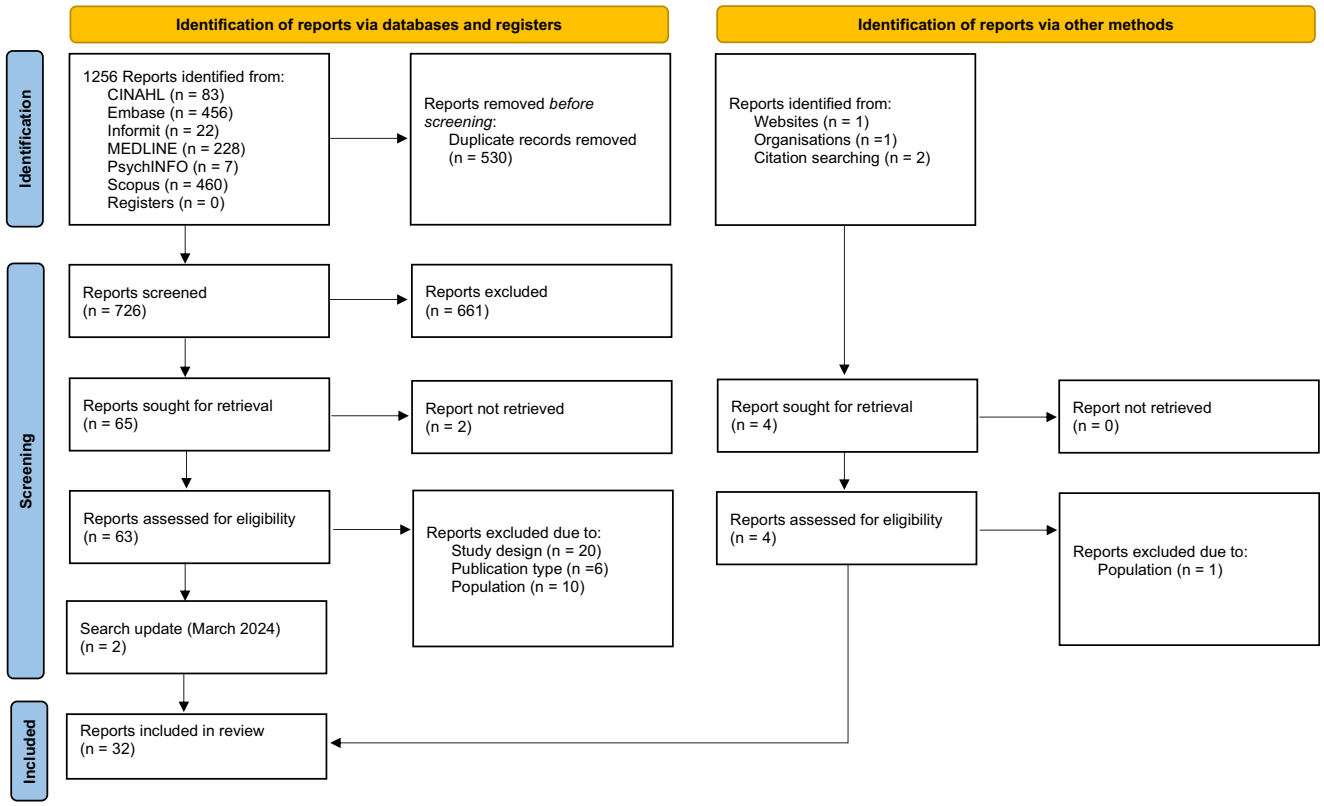

Figure 1: PRISMA 2020 flow diagram for new systematic reviews, which included searches of databases, registers and other sources (Page et al. 2021).

Results

Selection of sources of evidence

Initial searches identified 1,256 publications; after removing duplicates, 726 publications were screened by title and abstract to assess eligibility, of which 67 full-text articles were reviewed. Thirty articles met the inclusion criteria, including five publications from the grey literature. The updates search identified a further two articles for inclusion. Sources of evidence are detailed in the PRISMA flow diagram in Figure 1.

Characteristics of sources of evidence

Of the 32 included publications, most focused on primary prevention (n = 20) (Bailie et al. 2007; Bennett, 2014; Harch et al. 2012; Hayward et al. 2020; Jin et al. 2004; Krebs et al. 2013; Longstreet et al. 2005; Mayfield et al. 2000; McDermott et al. 2001; Morrison & Dooley, 1998; Oster et al. 2010; Pedersen, 2019; Pedersen & Jacobsen, 2011; Ramesh et al. 2008; Schoen et al. 2010; Schoen & Thompson, 2016; Turner & Avery, 2006; Virani et al. 2006; Watson et al. 2001; Win Tin et al. 2016). Sixteen publications included a component of foot screening within a more comprehensive diabetes quality improvement (QI) project, three described health promotion materials (Schoen et al. 2010; Schoen & Thompson, 2016; Watson et al. 2001), and one described the effect of a diabetes self-management program on foot care (Krebs et al. 2013).

Six were secondary prevention managing DFD. One focused on treating the symptoms of diabetes-related

peripheral neuropathy using acupuncture (Bailey et al. 2017), whilst four described foot protection services, including two articles by West et al. (2020, 2022) that reported different aspects of the same intervention (Ballestas et al. 2014; Browne & Garrett, 2010; West et al. 2022; West et al. 2020), and the other described a unique Indigenous-led service brokerage model that included podiatry (North Coast Aboriginal Corporation for Community Health, 2009).

There were two tertiary level interventions, with one describing a DFU management protocol (Loewen et al. 2017) and the other evaluating the experiences of health workers using telehealth services for diabetes-related foot complications in remote and rural communities (Graham et al. 2023).

The remaining four publications detailed comprehensive DFD interventions describing aspects of the foot protection services, foot interventions spanning primary prevention and secondary management (Cooper et al. 2007; Humphrey et al. 1996; Rith-Najarian et al. 1998; Schraer et al. 2004).

Publications relating to Indigenous peoples from Australia were most common, followed by those from Canada and the USA. The remainder consisted of two publications each from Aotearoa New Zealand (Browne & Garrett, 2010; Krebs et al. 2013), Greenland (Pedersen, 2019; Pedersen & Jacobsen, 2011) and the Pacific island country of Nauru (Humphrey et al. 1996; Win Tin et al. 2016). Publication numbers have remained consistent over the past two decades.

Nineteen publications described or evaluated an intervention with a foot component. The remainder were standalone DFD interventions (see Table 1 for details).

CONSIDER statement reporting guide

Three descriptive publications were not reviewed against the CONSIDER statement reporting guide, as they described an existing service with no new intervention. The articles were included to capture information regarding their approach to intervening in DFD service delivery. They were not treated as publications reporting on researching with Indigenous peoples (Morrison & Dooley, 1998; North Coast Aboriginal Corporation for Community Health, 2009; Turner & Avery, 2006). For the remaining 29, the reviewers agreed on two-thirds of the CONSIDER framework items and reached consensus on the remaining one-third. Two publications reported all 16 criteria evaluated, and another reported 15. The three most reported criteria were prioritisation (n = 28, 88%), partnership agreements (n = 24, 75%) and methodologies (n = 23, 72%). The three least reported criteria were consent for secondary use of data (n = 6, 19%), capacity – supporting Indigenous research (n = 8, 25%) and governance – protecting Indigenous knowledge (n = 10, 31%). The proportions of studies that reported each domain and category are shown in Figure 2, with CONSIDER statement completeness of reporting available and summary of researching with Indigenous peoples available in Supplementary Tables S1 and S2.

Summary of results

There were 13 standalone interventions, of which eight provided evaluation of the interventions they reported and the remaining five described the reported intervention. Of the 19 integrated interventions, 16 provided evaluation of the reported intervention and there were three descriptive accounts. Details of the interventions are précised in Supplementary Table S2.

Standalone diabetes-related foot interventions

There were varied approaches to target DF specific interventions. A study by Bailey et al. (2017) reported

Principal intervention Level	Primary prevention n = 20	Secondary prevention n = 6	Tertiary management n = 1	Comprehensive intervention n = 5	Total reports n = 32
Country					
Aotearoa New Zealand	1	1	0	0	2
Australia	8	4	0	2	14
Canada	5	0	1	0	6
Greenland	2	0	0	0	2
Nauru	1	0	0	1	2
USA	3	1	0	2	6
Year of publication					
1990–1999	1	0	0	2	3
2000–2009	9	1	0	2	12
2010–2024	10	5	1	1	17
Standalone/integrated					
Standalone DFD	5	4	1	3	13
Integrated	15	2	0	2	19

DFD = diabetic foot disease.

Table 1: Characteristics of included publications according to principal intervention level

the effect of a 10-week course of acupuncture on peripheral neuropathy symptoms and the effects on endothelial function demonstrating a reduction in peripheral neuropathy symptoms. However, there appeared to be no involvement of Indigenous stakeholders and the acceptability of the intervention for this Indigenous population was uncertain, as more than half of those approached declined to be involved, and all study participants wanted to be in the treatment group. Another publication, a doctoral thesis, focused on improving foot screening at an Indian healthcare provider by identifying barriers to screening (Bennett, 2014). The subsequent intervention was unsuccessful, with no improvement in foot screening; this contrasts with other studies in this review that included foot screening as part of a broader diabetes QI project. There was no consumer involvement despite identifying a lack of patient preparedness as a barrier. An Aotearoa New Zealand mixed methods study aimed to improve DFD outcomes for Indigenous Māori by ensuring that the intervention was consistent with Māori values (Browne & Garrett, 2010). This study was one of two that the authors agreed reported all 16 CONSIDER items. At the end of 1 year, the intervention group demonstrated an improvement in diabetes knowledge, and had better access to podiatry services, referrals and attendance to other services. This study also detailed the barriers and facilitators for Māori accessing podiatry services, highlighting the importance of cultural competence in the health workforce. Similarly, an Australian mixed methods study that evaluated a university-led foot clinic designed to include culturally appropriate service components for Aboriginal and Torres Strait Islander peoples found that it encouraged community engagement and self-reported improved foot health and greater self-care knowledge (West et al. 2022).

The four other standalone studies evaluated how interventions, including foot examinations combined with DFD management services and education or health promotion, impacted amputation rates for Indigenous peoples (Humphrey et al. 1996; Mayfield et al. 2000; Rith-Najarian et al. 1998; Schraer et al. 2004). One found that the type of foot examination did not

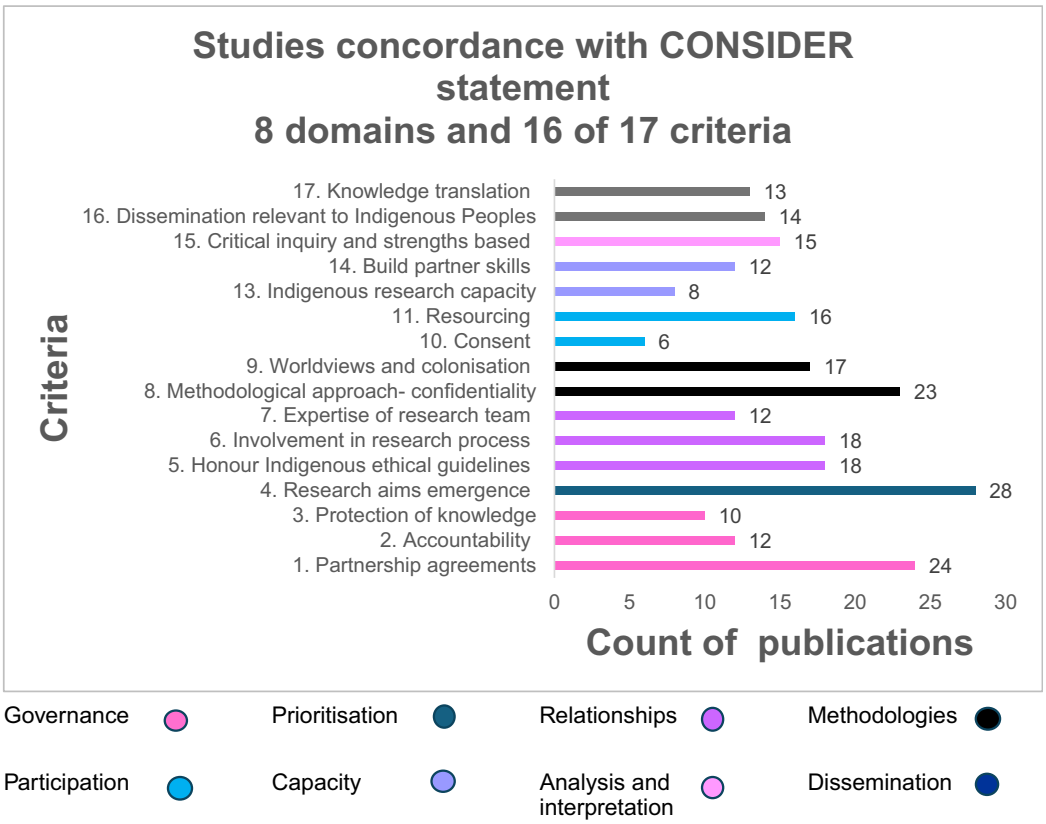

Figure 2: Count of studies in concordance with CONSIDER statement criteria and domains.

modify amputation risk at the 3-year follow-up. Foot care behaviours and medication adherence were associated with a non-significant increased risk for amputation (Mayfield et al. 2000). In contrast, Rith-Najarian and colleagues introduced foot screening, risk stratification and implemented guidelines and staged DFD management with an associated 48% reduction in amputation from 22/1,000 to 15/1,000 (Rith-Najarian et al. 1998). Schraer and colleagues achieved comparable results with a comprehensive high-risk foot program with Alaskan Natives, showing a 64% decrease in the overall amputation rate for the three Indigenous populations (Schraer et al. 2004). Similarly, the *Love Your Feet* program implemented in Nauru was associated with reduced amputations (Humphrey et al. 1996). This program was like the previous two, in that it was comprehensive with foot screening, DFD management and education about foot care. In addition, it had a national public health promotion component with footcare messages disseminated via schools, health clinics, retail outlets and national television.

Health promotion also featured in three descriptive Australian publications (Schoen et al. 2010; Schoen & Thompson, 2016; Watson et al. 2001). West et al. (2020) described the foot health of Aboriginal and Torres Strait Islander peoples attending a culturally safe university-based foot clinic. Another described approach used health administrative data and

established a DFU management protocol to enhance lower limb outcomes for First Nations peoples in Ontario (Loewen et al. 2017).

Integrated interventions

The QI projects that included an outcome measure assessing the number of foot checks that were undertaken (Bailie et al. 2007; Cooper et al. 2007; Harch et al. 2012; Hayward et al. 2020; Jin et al. 2004; Longstreet et al. 2005; McDermott et al. 2001; Oster et al. 2010; Pedersen, 2019; Pedersen & Jacobsen, 2011; Ramesh et al. 2008; Virani et al. 2006; Win Tin et al. 2016) demonstrated that foot checks were amenable to improvement. The studies used a combination of QI activities, including: team changes, electronic patient registries, continuous QI, audit and feedback, clinical education, clinician reminders and patient education. It is uncertain whether improvements in the number of foot checks undertaken would be sustained. Pedersen (2019) demonstrated a decrease in foot screens after 2 years, and another study showed a decrease in foot screening post-intervention (Bennett, 2014). Promisingly, McDermott et al. (2001) showed a reduction in hospitalisations for infected foot ulcers when foot screening was combined with early recognition and aggressive management of foot infections. One study did evaluate DFD outcomes as part of a comprehensive diabetes management QI project in Nauru where, in addition to increased foot screening, Win Tin et al. (2016) demonstrated a reduction in the prevalence of foot risk factors and ulcerations from 8.9% to 4.9%. There was a marginal increase in amputations. This intervention had a strong foot focus building on the earlier *Love Your Feet* program study, which found an initial fall in amputation numbers (Humphrey et al. 1996).

Of the three remaining publications, one was an Aotearoa New Zealand study that evaluated the effect of diabetes self-management education on self-foot examinations and showed an improvement at 3 and 9 months for all ethnicities (Krebs et al. 2013). Another Australian study improved engagement with services when developing an outreach diabetes and podiatry service sensitive to Indigenous needs and in partnership with the local Aboriginal community (Ballestas et al. 2014). Daily self-foot checks appeared amenable to sustained improvement, but it remains unknown whether this translates to improved foot outcomes, as related outcome measures were not included. The other was a brief one-page report describing an Indigenous-led organisation that used a brokerage model for procuring podiatry services to fill any identified service gaps (North Coast Aboriginal Corporation for Community Health, 2009). Details of the key components of included publications are précised and available in Supplementary Table S2.

Strategies to improve care

Studies focused on improving care for Indigenous peoples and included statements regarding Indigenous engagement. Approaches included working with Indigenous health workers (Bailie et al. 2007; Cooper et al. 2007; Longstreet et al. 2005; McDermott et al. 2001; Oster et al. 2010; Ramesh et al. 2008; Virani et al. 2006; Win Tin et al. 2016), working with Indigenous health provider organisations (Bailie et al. 2007; Ballestas et al. 2014; Harch et al. 2012; Hayward et al. 2020; Jin et al. 2004; Longstreet et al. 2005; Mayfield et al. 2000; McDermott et al. 2001; Ramesh et al. 2008; Virani et al. 2006; Win Tin et al. 2016), working with interpreters (Bailie et al. 2007; Virani et al. 2006), working with the local community (Ballestas et al. 2014; Hayward et al. 2020; Oster et al. 2010) and involving community Elders (Cooper et al. 2007). Two described how this impacted the evaluated outcomes, where they found that results were more favourable

when care was delivered by upskilled Indigenous health workers (McDermott et al. 2001), which increased attendance and trust (Cooper et al. 2007). Two Australian studies incorporated cultural competency training for staff as part of the service improvement strategies (Bailie et al. 2007; Ballestas et al. 2014). West and colleagues described a university-led clinic that incorporated culturally appropriate elements such as yarning circles and group appointments with the intention of creating a service that was seen as culturally safe by Indigenous clients and as providing an opportunity to enhance podiatry students' cultural competency (West et al. 2022). The remainder were two publications from Canada and reported using First Nations staff or those specially trained in working with First Nations peoples and being accompanied by local community representatives (Oster et al. 2010), whilst another prioritised Cree speaking and/or Indigenous health workers (Virani et al. 2006).

Other described approaches included developing health promotion and education resources focused on footcare and prevention (Schoen et al. 2010; Schoen & Thompson, 2016; Watson et al. 2001). One worked with an Aboriginal media company and Indigenous actors to develop two edutainment videos on preventing amputations (Schoen & Thompson, 2016). The other two studies worked with local communities to establish health promotion materials for foot care education, engaging local Indigenous artists. Interestingly, one wanted actual images (Schoen et al. 2010) and not cartoons, whereas the other group wanted material that featured drawings (Watson et al. 2001). Three other studies developed health promotion and education materials as part of a broader intervention (Cooper et al. 2007; Humphrey et al. 1996; Longstreet et al. 2005). All wanted localised, culturally relevant solutions of their choice.

Turner and Avery (2006) described an in-service DFD training day combined with retinal screening and lifestyle education (Turner & Avery, 2006). Another study described the foot health of an Indigenous population seen at two clinics integrated into the undergraduate podiatry program (West et al. 2020). An Indigenous podiatrist and an Aboriginal community health worker led the service. The service was described by the authors as culturally safe and highlighted the need to incorporate culture, place and family as part of care (West et al. 2020). The organisation of care was a feature of two quite different approaches: the Indigenous-led brokerage model for procuring podiatry services (North Coast Aboriginal Corporation for Community Health, 2009) and a DFUs and peripheral arterial disease management protocol to address high amputation rates for the local First Nations peoples (Loewen et al. 2017). Morrison and Dooley (1998) outlined a preventative and management diabetes initiative for the Sioux peoples to overcome the challenges of delivering care to a remote and sparsely populated region. It included a well-received travelling footcare program delivered by nurse educators trained in advanced foot care.

Addressing issues around access was incorporated in other studies predominantly linked to the physical remoteness of communities and included either outreach services (Cooper et al. 2007; Longstreet et al. 2005; McDermott et al. 2001; Schraer et al. 2004) or mobile units (Oster et al. 2010; Virani et al. 2006). One utilised telehealth to connect rural health providers and service clients with specialist DFD and vascular services for the management of DFUs (Graham et al. 2023). A combined mobile screening and telemedicine service demonstrated high client satisfaction and proved to be cost-effective in delivering foot and retinal screening to First Nations communities in

Northern British Columbia, Canada. However, beyond making services more accessible, it was unclear whether any culturally specific approaches were used (Jin et al. 2004). Mobile services were also used in an urban setting to meet the needs of Indigenous stakeholders (Ballestas et al. 2014). Cooper et al. (2007) developed a culturally safe outreach bringing together primary and secondary care services across medical, nursing, allied health and technical services.

Discussion

Most of the literature in this review reported primary prevention strategies and predominately focused on DFD screening within broader diabetes care QI projects to improve outcomes for Indigenous peoples. Developing health promotion and education resources was also reported as another primary prevention approach. Six studies described strategies to manage DFD affecting Indigenous peoples, and one provided a summary of a protocol to manage DFUs. Most studies reported on strategies to improve outcomes for Aboriginal and Torres Strait Islander peoples. The other main geographical regions were the USA and Canada. The remainder consisted of two publications each from Aotearoa New Zealand, Greenland and Nauru. No publications were found involving the Indigenous peoples from Taiwan, Hawaii or Northern Scandinavia referred to by Huria et al. (2019) in the development of the CONSIDER statement. Most publications were published in scientific journals, with five studies published in non-peer-reviewed grey literature, contrasting with a systematic review of Australian diabetes-related foot health programs for Aboriginal and Torres Strait Islanders, where most reports were published in grey literature (Littman et al. 2021).

When researching outcomes that impacted Indigenous peoples, 55% of the studies did not report on nine or more of the CONSIDER statement domains, with two studies that were evaluated reporting on all 16 (Browne & Garrett, 2010; West et al. 2022). Six studies reported four or fewer of the CONSIDER requirements (Bennett, 2014; Loewen et al. 2017; Mayfield et al. 2000; Pedersen, 2019; Pedersen & Jacobsen, 2011; Rith-Najarian et al. 1998), with consent for secondary use of data being the least frequently reported criteria (n = 6, 21%). The CONSIDER statement, developed to enhance reporting in health research involving Indigenous peoples, was retrospectively applied to studies published before its existence. The authors focused on reported data rather than the actual practices, underscoring the difference between doing and reporting in the context of increasing ethics requirements emphasising Indigenous rights and equity.

Key findings

Foot screening meets the criteria for a good indicator on the preventive pathway. Still, it may have limited benefit without onward referral to initiate proven preventative measures to manage risk factors and DFD (NHS Digital, 2018). Foot screening was the most frequently assessed outcome, possibly because it is often missing, it is simple to carry out and can predict the risk of developing a DFU (Sibbald et al. 2012). Three key risk factors – loss of protective sensation, non-palpable pulses and a history of previous ulcer or amputation – have been shown to accurately predict the 2-year risk of developing a DFU, which is the major precursor of amputations (Chappell et al. 2021). Very few studies provided details on the incidence of DFUs or rates of amputations, so it was difficult to ascertain whether there was any benefit from increasing the rates of foot screening. Studies that measured foot screening also frequently evaluated glycaemic control and lipid and hypertension management (Bailie et al. 2007; Harch et al. 2012; Hayward et al. 2020; Longstreet et al. 2005;

McDermott et al. 2001; Oster et al. 2010; Pedersen, 2019; Pedersen & Jacobsen, 2011; Ramesh et al. 2008), which have been implicated as risk factors for DFD and are more prevalent in Indigenous populations (Crowshoe et al. 2018; Schoen & Norman, 2014). However, due to the lack of DFD outcome measures, it was unclear whether metabolic management changes positively affected DFD outcomes (the exception being Win Tin et al. (2016), who demonstrated a reduction in foot risk factors and DFUs). Data availability on DFU hospitalisations and amputations may potentially influence the use of these outcome measures, but studies did not indicate that this was a barrier. Whilst foot screening is an easy outcome to influence, the emphasis must be tempered with action to manage risk factors and DFD. Moving beyond counting foot screens to evaluating the effectiveness of interventions for Indigenous peoples is essential. It requires outcome measures that monitor the preventable complications of DFD such as the rate of first and subsequent DFUs, foot-related hospital admissions and amputations (Tricco et al. 2012).

Consideration of data must encompass both its nature and capacity to capture Indigenous perspectives. Indigenous research praxis offers a means to give voice to these perspectives (Reid et al. 2019), prompting non-Indigenous researchers to consider their approach to advancing the decolonisation of health research. For instance, West et al. (2022) integrated yarning circles into their study on a foot service for Aboriginal and Torres Strait Islander peoples, illustrating how mainstream health service delivery can be decolonised to align with community needs. Additionally, Reid et al. (2019) emphasised the importance of acknowledging the type of data and metrics employed to ensure inclusion of Indigenous viewpoints. West et al. (2022) and Browne and Garrett (2010) demonstrated this by adopting a mixed methods approach, combining Western measurements of health with culturally sensitive methods such as yarning circles and wānanga. Such inclusive methodologies are essential to advance the implementation of equity focused mainstream healthcare interventions (Gustafson et al. 2024).

Perhaps more important is access to proven foot protection services (Albright et al. 2020; Paisey et al. 2018). Four studies demonstrated the effectiveness of foot screening combined with proactive management, with a reduction in foot DFUs, significant reductions in amputations (Rith-Najarian et al. 1998; Schraer et al. 2004; Win Tin et al. 2016) and foot-related hospitalisations (McDermott et al. 2001). An Australian diabetes care QI study with remote Indigenous communities demonstrated a reduction in the proportion of diabetes-related hospitalisation for infected DFUs from 16% to 9% by educating about the importance of early recognition and aggressive management of infections (McDermott et al. 2001). The 75% uptake of foot screening and 75% podiatrist checks compared with control group rates (61.5% and 30.8%, respectively) may have also aided early recognition of infections. This is important, as late presentations of acute DFU complicated by infection have been indicated as a driver of diabetes-related foot hospitalisations, higher amputation rates and increased mortality (Guest et al. 2018; NHS Digital, 2018). This intervention also engaged and upskilled Indigenous health workers in diabetes care, which translated to patients receiving more regular structured contact with primary care and podiatry services and improved outcomes. Additionally, Browne et al. (2010) showed that care organisation proved influential when improving access to podiatry and other specialist services, demonstrating positive outcomes for Māori (Aotearoa New Zealand) in these

aspects of foot care. There is also the potential to positively influence diabetes outcomes, with the intervention group showing increased diabetes knowledge (Browne & Garrett, 2010; West et al. 2022). Changes in access to foot care have the potential to positively impact other aspects of healthcare and vice versa.

Publications make scant comment on the more upstream causes of inequities in health outcomes such as colonisation, racism and the socioeconomic determinants of health. Most studies focused on clinical outcomes and the underlying barriers to accessing healthcare. Improving access to diabetes screening and healthcare services was achieved by employing strategies such as outreach healthcare services, mobile screening units and working with Indigenous health providers and Indigenous health workers. Mobile primary healthcare has been seen as a remedy to accessing health services for remote Indigenous communities, but evaluations to support their use and acceptability are limited (Beks et al. 2020). Links to the community and other health services were not always evident, and sustainable funding could be challenging (Jin et al. 2004). Telehealth presents an opportunity to enable DFD care (Hazenberg et al. 2020; Iversen et al. 2020) and is a consideration for rural and remote communities to more readily access care whilst enabling people to stay ensconced in their cultural support systems (Pinero de Plaza et al. 2023). Opportunities to use telehealth to support improved access to specialist care for the management of DFD was reported as reducing travel burden and enabled people to stay connected to others and to stay on their land (Graham et al. 2023).

Racism is an established determinant of health (Paradies et al. 2015) yet it was only discussed in two publications (Browne & Garrett, 2010; West et al. 2022). Pedersen (2019) discussed the impact of colonisation on health and culture. In some instances, cultural safety was considered to help make services more amenable to Indigenous peoples. Cultural safety demonstrated by healthcare services and individuals delivering care is considered key to providing equitable care for Indigenous peoples (Curtis et al. 2019; Gerrard et al. 2021) and if not addressed can contribute to poorer foot outcomes (Sadler et al. 2022). Fostering culturally safe practices can also positively impact diabetes care (Tremblay et al. 2020). Strategies to provide more equitable care for Indigenous peoples were varied, with studies describing engagement with Indigenous health providers, health workers, community workers, communities and Elders; however, the impact of these strategies was not reported, making it difficult to ascertain the benefits. Two studies in this review incorporated cultural training for non-Indigenous staff (Bailie et al. 2007; Ballestas et al. 2014). Two papers reported components of a study that described incorporating student training with a culturally safe foot clinic led by Indigenous staff to build the cultural capability of undergraduate podiatry students (West et al. 2022; West et al. 2020) and another highlighted the importance of a Kaupapa Māori approach, with the intervention being led by Māori health professionals (Browne & Garrett, 2010).

Comprehensive approaches to foot care interventions are crucial for preventing first and subsequent DFUs and reducing hospitalisations and amputations. Systematic reviews have identified this need in the general population (Crawford et al. 2020; Monteiro-Soares et al. 2021; van Netten et al. 2024). However, reporting remains underdeveloped for Indigenous populations (Blanchette et al. 2023; Chuter et al. 2019). Footwear and orthotics are identified as key

components of prevention, but only two studies described the inclusion of therapeutic footwear. One of those was unable to source suitable footwear for the remote Indigenous population, emphasising potential barriers to using preventative therapeutic footwear (Watson et al. 2001). In addition, acceptance of therapeutic footwear in the general population is reported as low (Barwick et al. 2019). Until recently, reference to the perspectives of Indigenous peoples pertaining to maintaining foot health had been missing from DFD guidance in relation to footwear protection for prevention. The 2021 Australian DFD Guidelines now acknowledge the Australian First (Indigenous) peoples and consider cultural needs, local geographical and health access variation as relevant (van Netten et al. 2018). Diabetic foot disease footwear needs to be further explored in First Nations peoples as an initial step for identifying effective solutions that account for cultural practices regarding footwear and unique local footwear requirements.

None of the reviewed publications considered cultural significance of feet connecting Indigenous peoples to place and land. Researchers have appeared to have missed an opportunity to learn from Indigenous peoples and potentially consider feet from a different perspective that could influence approaches to foot health messaging and care. This is an area that seems under-conceptualised and researched.

The items and domains of the CONSIDER statement are not ranked by importance but are all equally imperative to improving health outcomes for Indigenous peoples. It may be too soon to gauge the impact of the recently published (2019) CONSIDER statement (Huria et al. 2019), but it is evident that substantial work needs to be done to improve reporting on research with Indigenous peoples and DFD. Reporting on researching 'with' Indigenous peoples appears to have decreased over the recent decade (2011–2020), with this review finding that six of 11 studies that reported ≥ 10 of the CONSIDER domains were published in 2010 or prior and two others in the last 3 years. At times, publishing requirements made it difficult to find detail on direct Indigenous contributions and the authors' and researchers' positioning concerning researching with Indigenous peoples or authors tribal affiliations. One publication that reported all 16 domains was a 163-page report from grey literature, so was not confined by word count limitations of research journals, meaning that the authors were able to provide more detail, particularly for the less frequently met domains. However, the other was a recent journal publication demonstrating what degree of reporting can be achieved. Both publications were led by Indigenous researchers, which may have been an influencing factor as the studies used Indigenous research praxis. The publishing criteria for substantive contribution defined by International Committee of Medical Journal Editors (ICMJE) could have influenced identifying item 7: Expertise of the research team. Indigenous research expertise of the team as Indigenous or cultural advisors are not mentioned as inclusion categories. The current authorship recommendations rely on a narrow definition of contributor roles that may not capture the people at the heart of Indigenous participatory research projects. Perhaps a call like that found in conservation science research (Cooke et al. 2021) might prompt medical journal authorship criteria to be more inclusive and could drive changes in practice alongside funder requirements and ethics committees. This could permit authorship to encompass other roles contributing to knowledge development and research publication. It is hoped that the introduction of the CONSIDER statement might drive change in journals' expectations of reporting and conduct of research that affects Indigenous peoples.

Strengths and limitations

A strength of this approach to this scoping review was the partnership approach with Indigenous expertise during the conceptualisation and development of the review. Indigenous interpretations of the publications highlighted the presence or absence of key concepts such as reciprocity and self-determination, allowing non-Indigenous authors to recalibrate their perspectives and achieve a shared understanding of these crucial concepts. In a recent publication, Brodie et al. (2023) discussed the potential of scoping reviews to incorporate Indigenous ways of knowing and being, which was reflective of the current experience.

This scoping review had some limitations. Only publications from high-income countries were included, possibly missing DFD interventions for Indigenous peoples from low- and middle-income countries. The authors worked with a non-Indigenous specialist librarian to establish a comprehensive and inclusive search strategy for Indigenous populations from high-income countries; however, indexing strategies of major health literature databases may have meant that some studies were missed (Harding et al. 2021). Furthermore, a non-Indigenous specialist librarian might lack cultural knowledge to select appropriate search terms for capturing the nuances of Indigenous health concepts. To mitigate this, an Indigenous academic (BI) was involved in developing the search strategies.

Some titles and abstracts were only reviewed by two non-Indigenous reviewers. This may have meant that some articles with a nuanced Indigenous perspective may have been overlooked. However, this was ameliorated with the clear inclusion criteria and the Indigenous reviewer being available to view and discuss any queries that were flagged.

Evaluating articles in isolation against the CONSIDER statement may mean that information about the context of the study was missed. For example, dissemination, knowledge translation and ongoing governance often cannot be gleaned from the study publications.

Conclusions

This review found a small number of studies describing interventions that improved DFD outcomes and reduced the impact of DFD for Indigenous peoples. Comprehensive interventions that included people skilled in the management of DFD improved outcomes. However, authentic engagement with Indigenous communities in the research and development of DFD interventions was rare. It is recommended that, for future projects, researchers focus on collaborating with local Indigenous peoples to weave Indigenous knowledge and priorities into developing comprehensive DFD interventions. The CONSIDER statement provides useful guidance for all stages of research with Indigenous peoples.

Author contributions

MG, BI, RM and TK: Conceptualisation. MG, BI and TK: Methodology. MG, BI and TK: Formal analysis. MG: Writing - original draft. MG, BI, RM and TK: Writing - review and editing.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author biographies

Michele Garrett is a non-Indigenous researcher and podiatrist in Aotearoa New Zealand. She has 25 years of clinical experience with the high-risk foot and works as the Professional Lead, Podiatry for Te Whatu Ora; Te Toka Tumai Auckland and Waitematā. Michele's research focuses include the cultural context of living in Aotearoa and its impact on attitudes towards diabetes-related foot issues for Māori and non-Māori. Currently, a PhD candidate at the University of Auckland, she is exploring using administrative data to reduce diabetes foot problems and tackle health inequities.

Dr Belinda Ihaka is an Indigenous Māori scholar from the far north iwi, Te Aupōuri in Aotearoa New Zealand. She is a senior lecturer in the School of Clinical Sciences, Department of Podiatry at AUT. She is the current chair of the Podiatrist Board of New Zealand and has 20 years of clinical experience in the high-risk foot. Her research aims to improve health equity, with a focus on long-term conditions.

Rinki Murphy is a non-Indigenous researcher, Professor of Medicine at the University of Auckland and academic endocrinologist specialising in diabetes and obesity. She has established a research program in understanding the pathophysiology and impacts of diabetes and obesity aiming to identify precision medicine that spans genetics, broader risk biomarkers and novel treatment strategies. She established the Aotearoa New Zealand monogenic diabetes national genetic testing guidelines. She works clinically at Te Whatu Ora, Auckland Diabetes Centre, Te Toka Tumai and Clinical Head, Te Mana Ki Tua, Specialist Weight Management Service at Counties Manukau.

Timothy Kenealy is a non-Indigenous researcher and academic general practitioner. He worked in South Auckland for over 25 years and is currently providing virtual consultations for a rural marae clinic working with a prescribing nurse who provides face-to-face consultations. His involvement in multiple practice improvement efforts locally and nationally led to an academic career path, completing a PhD and then appointed as Associate Professor of Integrated Care at the University of Auckland 2006–2022. His research has centred around type 2 diabetes, long-term conditions, antibiotics in respiratory infections, improving service delivery in primary healthcare, and equity of health outcomes.

Supplementary material

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