Traditional, complementary and integrative medicine use among Indigenous peoples with diabetes in Australia, Canada, New Zealand and the United States

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Abstract

Objective: This systematic review aimed to describe traditional, complementary and integrative medicine (TCIM) use among Indigenous peoples with diabetes from Australia, Canada, New Zealand and the United States (US).

Methods: A systematic search following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement guidelines was conducted. Data were analysed using meta-aggregation.

Results: Thirteen journal articles from 12 studies across Australia, Canada and the US were included in the review (no articles from New Zealand were identified). Indigenous peoples used various types of TCIM alongside conventional treatment for diabetes, particularly when conventional treatment did not meet Indigenous peoples' holistic understandings of wellness. TCIM provided opportunities to practice important cultural and spiritual activities. While TCIM was often viewed as an effective treatment through bringing balance to the body, definitions of treatments that comprise safe and effective TCIM use were lacking in the articles.

Conclusions: The concurrent use of TCIM and conventional treatments is common among Indigenous peoples with diabetes, but clear definitions of safe and effective TCIM use are lacking.

Implications for public health: Healthcare providers should support Indigenous peoples to safely and effectively treat diabetes with TCIM alongside conventional treatment.

Key words: traditional medicine, complementary therapies, diabetes, Indigenous peoples, integrative medicine

It is well documented that Indigenous peoples in Australia, Canada, New Zealand and the United States (US) experience higher rates of diabetes[1] and higher mortality rates from diabetes than their non-Indigenous counterparts.[2-6] These higher rates are attributable to a range of known risk factors including, central obesity, cigarette smoking, dyslipidaemia, albuminuria, inflammation and socioeconomic disadvantage.[7-11] Furthermore, the complications resulting from diabetes negatively affect one's health-related quality of life, with even mild diabetic complications being found to have a significant impact.[12]

People with diabetes are increasingly using complementary medicines alongside conventional diabetes care to improve their overall wellbeing.[13,14] The World Health Organization (WHO) defines complementary medicines as referring "to a broad set of health care practices that are not part of that country's own tradition or conventional medicine and are not fully integrated into the dominant health-care system".[15] Complementary medicine refers to healthcare, either self-administered or practitioner-led, and examples include massage, chiropractic and western herbal medicine.[16]

Indigenous culture, customs and lore often include traditional forms of healing to enhance health and wellbeing through reconnection to land, spiritual and ancestral roots.[17,18] Examples of traditional healing practices and medicines include singing/chanting, ceremonies, bush medicine, traditional healers and external remedies.[17,19,20] The WHO defines traditional medicine as "knowledge, skill, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health".[15] These traditional medicines and practices are usually unregulated and operate outside the public healthcare system, while complementary medicine refers to healthcare, both self-administered or practitioner-led.[16] The integration of these traditional knowledges in Primary Health Care has been posited as an important part in moving forward toward health equity globally. Indeed, this is supported by both the Astana Declaration and UNESCO's Convention on the Protection and Promotion of the Diversity of Cultural Expression.[21,22]

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Traditional,[19,23] complementary and integrative medicines[16] (hereafter, TCIM) is a catch-all phrase that includes a broad range of technologies, products, practices, practitioners, knowledge systems and approaches to healing and/or preventing illness and/or promoting wellbeing.[15,19] TCIM in the vast majority of cases are defined by their continuing provision and use beyond the routine focus of conventional medical practice.[16]

A recent worldwide systematic review reported the use of complementary medicines among people with diabetes ranged from 17% to 73%, with nutritional advice and supplements, herbal medicines, spiritual healing and relaxation techniques used most frequently.[13] It was further reported that many people with diabetes did not communicate their complementary medicines use to their healthcare providers.[13] A review of traditional medicines among North American Indigenous peoples for general health and wellbeing also found limited disclosure of use to healthcare providers.[20] This is concerning due to the potential for harmful interactions and compounding effects between complementary medicines and conventional diabetes care,[13,24] missed opportunities for culturally safe care[20] and the benefits of optimal integration of complementary medicines and conventional medical perspectives.

To our knowledge, there is limited evidence regarding Indigenous peoples diagnosed with diabetes use of TCIM alongside, or instead of, conventional medical practices from Australia, Canada, New Zealand and the US. This systematic review aims to describe TCIM use among Indigenous peoples with diabetes from Australia, Canada, New Zealand and the US.

Methods

A systematic review of the published literature was conducted to identify and describe TCIM use among Indigenous populations in Australia, Canada, New Zealand and the US.

Eligibility criteria

The review was limited to published articles that reported on Indigenous populations from Australia (Aboriginal and Torres Strait Islander), Canada (Aboriginal, First Nations, Inuit or Métis), New Zealand (Māori) or the US (American Indian, Native American, Alaskan Native, American Samoan, Eskimo and Native Hawaiian). As in our previous review on cancer patients,[25] these countries were included due to their shared history of colonisation and disproportionally poorer health in Indigenous populations.[26,27] The Indigenous populations of these four countries comprise of many diverse groups with distinct languages, beliefs and cultural practices, however, we respectfully refer to them collectively as 'Indigenous' for the purpose of this review. Books or book chapters, commentaries, literature reviews, editorials, poster abstracts, dissertations, articles published in languages other than English and efficacy studies were all excluded from this review.

Search strategy

The search aimed to identify peer-reviewed literature reporting original empirical data from qualitative, quantitative or mixed-methods studies examining TCIM use by Indigenous adults (18 years and older) with a diagnosis of diabetes from Australia, Canada, New Zealand and the US.

We searched AMED, AltHealthWatch, CINAHL, EMBASE, PsychINFO and MEDLINE via PubMed for records of original research published between January 2000 and April 2020 (the year 2000 was chosen due to changes in complementary medicine and service systems that might limit the applicability of studies prior to this date).[28] Keywords included using free-text terms representing: 1) Indigenous populations from and residing in Australia, Canada, New Zealand, and the US; 2) diabetes; and 3) TCIM (Table 1). Keyword selection was guided by our previous systematic review on TCIM use in Indigenous populations with cancer.[20] Diabetes search terms were selected using database-specific controlled vocabulary and broad free-text terms such as 'diabetes'. We further searched the reference lists of articles that had previously conducted systematic literature reviews on similar topics to ours (e.g. complementary medicine use), and those of articles identified for inclusion.

Review process

The systematic review process was guided by the Cochrane Collaboration[29] and the Centre for Reviews and Dissemination[30] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[31] as outlined in Figure 1.

After removing duplicates, authors AG and TB independently examined titles and abstracts using Rayyan systematic review software.[32] Articles not meeting eligibility criteria were excluded. All retrieved full-text articles were independently assessed by AG and TB and the reasons for excluding articles were documented and discrepancies were resolved by consensus. Extraction tables were developed by AG. AG and TB independently piloted the tables with three purposively selected articles. When consensus on data extraction was achieved, AG proceeded with the remaining data extraction independently. AG and TB met and resolved all discrepancies by consensus and consulted SL for any that could not be resolved. Extracted descriptive data were synthesised via the Joanna Briggs Institute's method of qualitative research synthesis (meta-aggregation) as it avoids re-interpreting data and attempts to accurately and reliably present the findings of included articles consistent with the intent of the original authors.[33] AG piloted this approach[33] and then proceeded with the synthesis of extracted findings into categories. TB reviewed the synthesis, then AG and TB met to resolve any discrepancies.

Ethics

Ethical approval was not required for this systematic literature review.

Results

Of the 176 records retrieved, 22 duplicates were removed, and 154 records were screened by title and abstract. An additional two records were identified through checking the reference lists. Of the 156 abstracts considered for inclusion, 22 full-text articles were assessed for eligibility and 13 records were subsequently considered eligible for inclusion (see Figure 1).

Characteristics of the included articles

The 13 articles represented 12 individual studies: three were conducted in Australia,[34-36] four in Canada,[37-40] none in New Zealand and six in the US.[41-46] Our sample included two mixed-methods articles,[40,45] five qualitative articles[34,36-39] and six quantitative articles[35,41-44,46] (including four cross-sectional, and one randomised controlled trial). Of the ten articles that reported geographical remoteness, urban[35,36,39,40,43] and rural areas[34,37,38,41,42] were equally represented. The included articles were conducted in a range

of clinical and community settings and most contained solely Indigenous (n=8; 73%[34,36-40,43,44]) and female participants (*range*=48% to 85.5%). Sample sizes varied extensively, from a small four-participant qualitative study,[38] to a quantitative study with 1,543 participants of which 243 were Indigenous.[35] Findings are reported only for those data that could be attributed to Indigenous participants specifically.

Few articles reported on the included participants' type of diabetes, with only three articles reporting they sampled participants diagnosed with non-insulin dependent diabetes mellitus.[35,36,39] Eight of the articles focused exclusively on TCIM use,[35,40-46] while the remaining articles reported TCIM use as a component of the broader research question.[34,36-39] The modalities and 'home remedies' considered to be TCIM varied greatly; for this reason, we are not able to report the percentage of TCIM use overall. Usage data for individual articles, where available, are reported in Table 2.

Factors affecting TCIM use was reported by five articles.[35,41,42,44,45] Two articles reported no distinguishable differences in patterns of use by education, gender/sex, age, duration of diabetes, ability to speak and understand English or insulin use.[44,45] One article with urban Native Americans found those who travelled for more than 60 minutes to access healthcare were more likely to use herbal medicines than those who only needed to travel for 30 minutes or less.[44] Similarly, another found that older adults with diabetes living in open country, a category in which Native Americans were over-represented, were more likely to use home remedies than those living closer to towns.[42] One article found Native Americans were more likely to use TCIM than 'whites'[41] while another reported Aboriginal Australians were less likely to use TCIM than people from other ethnic backgrounds (odds ratio 0.21 (0.10-0.44), $p<0.001$).[35] Lastly, one article found that approximately 20–35% of the difference in food and other home remedies use between Native Americans and whites was explained by the availability of care, economic hardship and health disparities (which the authors collectively called structured inequalities). Furthermore, the authors found ethnic differences in home remedies use persisted even after controlling for structural inequalities, so they suggest that cultural explanations (not explored in their research) are likely to explain these differences in use.[42]

Table 1: Free-text terms for all databases and controlled vocabulary for CINAHL.

Search Terms	
Indigenous Population Terms	[Title/Abstract search: Indigenous OR Aborigin* OR Torres Strait Islander* OR Māori* OR American Samoa* OR First Nation* OR Canadian Indian* OR Native American* OR American Indian* OR Inuit* OR Métis OR Eskimo* OR Alaska* Native* OR Aleut OR Native Hawaiian* CINAHL headings: Indigenous peoples OR American Samoa OR Native Americans]
Condition Term	**[Title/Abstract search: diabetes CINAHL heading: Diabetes Mellitus]**
Traditional, Complementary and Integrative Medicine Terms	[Title/Abstract search: complementary medicine* OR complementary therap* OR alternative medicine* OR alternative therap* OR natural medicine* OR natural therap* OR holistic medicine* OR holistic therap* OR Integrative medicine OR traditional medicine* OR bush medicine* OR traditional medicine practice* OR ethnomedicine* OR traditional healer* OR traditional practitioner* OR traditional health practice* OR native American medicine* OR Native American healing practice* OR spiritual treatment* OR medicine man OR medicine men OR native medicine* OR aboriginal healer* CINAHL headings: Alternative Health Personnel; Alternative Therapies; Research, Alternative Therapies; Detoxification, Alternative Therapy]

Figure 1: Study selection and PRISMA flow diagram.

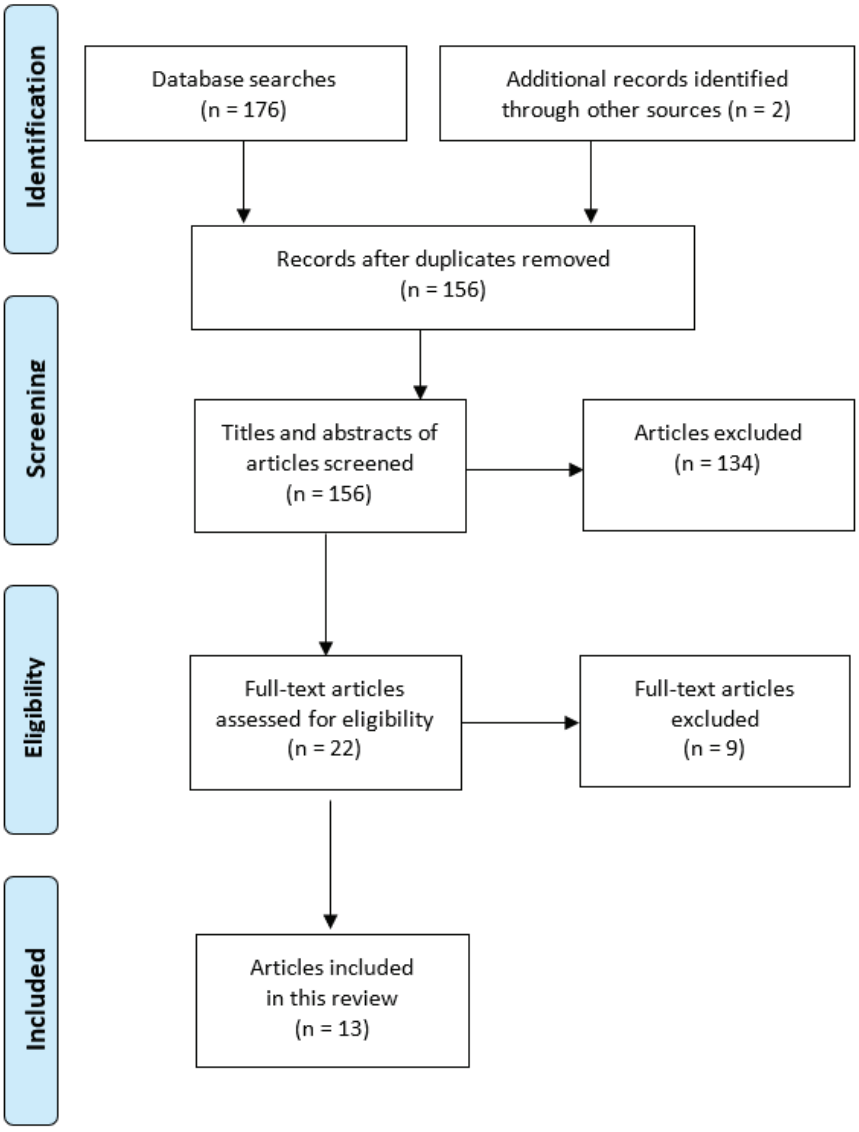

Table 2: combined summary extraction data for all included articles.

First-named Author (Year)	Indigenous population, specific nation and locality[a]	Sample size - whole sample/Indigenous sample (percent Indigenous)	Age	Sex (% female)	Prevalence TCIM use (overall Indigenous population usage)	Predictors of TCIM use (quantitative articles only)
United States						
Arcury[41] (2006)	Native Americans (two Central North Carolina counties)	697/180 (25.8%)	NIB	NIB	Native Americans and African Americans had greater odds of using food home remedies (ORs = 2.37 and 2.21, respectively) and other home remedies (ORs = 2.88 and 4.20, respectively) for diabetes care than Whites.[b]	Ethnicity[b]
Buchwald[43] (2000)	American Indian/ Alaska Natives, Seattle, Washington	829/829, 60 with diabetes (100%)	NDB	NDB	42 users, and 18 non-users of traditional health practices	NDB
Grzywacz[42] (2006)	Native Americans (two Central North Carolina counties)	698/181 (20.6%)	65-74 years old: 58.6% (106); 75-84 years old: 36.5% (66); 85+: 5.0% (9)	92 F; 89 M (50.8%)	60.2% of Native Americans used food home remedies; 67.9% used other home remedies (see Table 1, p. 44)	NIB
McCabe[44] (2005)	Native Americans, Navajo Indians	203/203 (100%)	NR	NR	Traditional Medicine use data for 195 participants. 58 of 195 (30%) reported using traditional herbs	Participants who travelled ≥ 60 min to reach clinic significantly more likely to use traditional herbs than those who travelled ≤ 30 min ($p<0.02$)[b]
Schoenberg[45] (2004)	Native Americans, Great Lakes Indians	80/20 (20%)	Mean: 66.15 SD: 5.88	60% F; 40% M	15% used CM	"No differences in these multiple use patterns were distinguishable." P.1064
VillaCaballero[46] (2010)	Native Americans	806/63 (7.9%)	NIB	NIB	"Native Americans were significantly more likely to use American ginseng and aloe vera compared to Caucasians… [traditional] Healers were used almost exclusively by Native Americans…"p.246[b]	NIB
Canada						
Barton[37] (2005)	Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia	8/8 (100%)	NR	5 F; 3 M (62.5%F)	"For all of the participants, the use of both western and traditional medicines was commonplace." P.243	NA
Barton[38] (2008)	Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia	4/4 (100%)	NR	3 F; 1 M (75%F)	NA	NA
Sherifali[39] (2012)	First Nations, Hamilton, Ontario	(79.2% with diabetes, 20.8% caregivers) (100%)	Ages ranged from 34 years to 83 years.	(85.5% F)	NA	NA
Waldram[40] (2000)	Canadian Aboriginals, Saskatoon (Plains Cree, Saulteaux, Northern Cree, Metis and Other Nations)	60/60 (100%)	Female mean = 47; Male mean = 55; median and SD NR	31% M; 69% F	34% had taken some form of Indian medicine in the past to treat their diabetes; 10% actively taking Indian medicine at time of interview; 19/60 have taken Indian medicine for diabetes[b]	NR
Australia						
Dussart[34] (2009)	Aboriginal Australians, Warlpiri, Central Australia	84/84 (plus 14 family members) (100%)	range: 16 to 81; 16-29 = 19%; 30-49 = 25%; 50-69 = 35%; 70-81 = 21%[b]	60 F; 24 M (71.4%F)	NA	NA
Thompson[36] (2000)	Aboriginal Australians, Melbourne, Victoria	52/52b (100%)	Ages ranged from 20 years to 50 years[b]	12 F; 13 M with diabetes (48%F)	NA	NA
Yarash[35] (2020)	Aboriginal Australians (Fremantle, Western Australia)	1543/approx. 243 (15.7%)	NIB	NIB	Of 672 complementary medicine users, 17.1% identified as Aboriginal, approximately 115 people.	"CM use amongst… Aboriginal Australians …was less likely than those from other ethnic backgrounds." p.8. Odds ratio 0.21 (0.10-0.44), $p<0.001$. p.21.

Notes:

Abbreviations: CM, Complementary Medicine; NA, not applicable; NDB, no disease breakdown; NIB, no Indigenous breakdown; NR, not reported; TCIM, Traditional, Complementary and Integrative medicine; F, Female; M, Male.

a: if supplied in article

b: abbreviated for table, see source article for more detail.

Descriptive data synthesis of findings

Following meta-aggregation, thematic analysis revealed three broad themes: 1) Types of TCIM used; 2) Reasons for TCIM use; and 3) TCIM co-treatment. The Indigenous population, specific Indigenous nation and locality (if supplied in the article) and country is provided alongside each extract.

Types of TCIM used

Participants reported using multiple types of TCIM to treat their diabetes condition. There were large variances across the articles in what was classified as being a traditional or complementary medicine. The most widely used complementary medicines reported in two articles (one study) among older rural adults with diabetes included other home remedies (67.9% of participants) such as tobacco, WD-40, Epsom salts, Vic's VapoRub, liniments, salves, kerosene or turpentine, and motor oil.[41,42] Food Home Remedies (60.2%), such as honey, lemon and garlic baking soda, yeast, teas or whiskey were also widely used among these rural participants.[41,42] Although Arcury and colleagues (2006) provided specific usage statistics of other home remedies and food home remedies, this was not broken down by Indigenous status. However, yeast, teas, whisky, tobacco, kerosene/turpentine, WD-40 and motor oil were all used by fewer than 10% of all the participants (African American n=220, Native American n=180, White n=297). Furthermore, these articles provided little detail on what purpose many of the remedies served for the participants. For example, kerosene and turpentine were reported to be "used topically on wounds and orally for colds", and WD-40 was "used to relieve joint pain".[41(pS65)] Other remedies were merely listed as being for either health purposes or diabetes care.

These home remedies differ from other articles that reported on traditional medicine use, which included various ceremonies, topical and ingested remedies traditionally used by the respective Indigenous populations:

> *From a traditional perspective, this included the use of food and medicinal plants, and ceremonial practices such as healing circles.*[37] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia, Canada

> *Examples provided included taking herbal medicine, smudging, and participating in specialised healing or sweat lodge ceremonies.*[43] American Indian/Alaska Natives, Seattle, Washington, US

> *"Religious or spiritual…* [traditional medicines] *… were also grounded in cultural background. Several Native American respondents recommended involvement in sweat lodges, native healing ceremonies, and dance rituals.*[45] Native Americans, Great Lakes Indians, US

> *… Aboriginal spiritual ceremonies, especially sweat lodges*[40] Canadian Aboriginals, Saskatoon (Plains Cree, Saulteaux, Northern Cree, Metis and Other Nations), Canada

The use of herbal and tea-based remedies was commonly reported throughout the included articles (eight of the 13 articles reported this use):

> *27 different plants identified – sage most frequently mentioned (15%) with cedar/juniper at 10%.*[44] Native Americans, Navajo Indians, US

> *… water and old man weed … ; water, apple cider vinegar, extracts from the tree or old man weed.*[36] Aboriginal Australians, Melbourne, Victoria, Australia

> *Herbal medicines; weekas, muskeg tea, pine tea, cedar tea (most commonly used was teas).*[40] Canadian Aboriginals, Saskatoon (Plains Cree, Saulteaux, Northern Cree, Metis and Other Nations), Canada

Reasons for TCIM use

Reasons for using TCIM varied across the included articles. In some instances, TCIM was described in the treatment of diabetes or for "health-related reasons", with no further elaboration on the reasons for use. This was mostly reported in the descriptive data presented in the quantitative articles included in our review.

> *… to assess use of traditional health practices, patients were asked if they had engaged in such activities for health-related reasons …*[43] American Indian/Alaska Natives, Seattle, Washington, US

> *…respondents indicating use of* [complementary medicines] *for diabetes …*[45] Native Americans, Great Lakes Indians, US

TCIM was reportedly used when participants felt that conventional biomedical diabetes treatment did not meet their physical, spiritual and psychological needs, or when diabetes was attributed to sorcery.[34,40] Participants expressed holistic understandings of the body, spirit, and health, in comparison to the approaches of conventional medicine, as a reason for using TCIM for diabetes.

> *… I go to a healing circle where we gather together and talk among ourselves. It's a way the spirit can help you heal. This is a powerful way for healing a diabetic. It provides strength to overcome the challenges.*[37] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia, Canada

> *Juggling two worlds described the challenges participants felt with balancing their culture and traditional ways, versus westernized medicine and philosophical approaches to diabetes management. Some felt that western medicine did not adequately meet their needs physically, spiritually and mentally, resulting in a return to more traditional methods of healing.*[39] First Nations, Hamilton, Ontario, Canada

> *More than half the interviewees – among the older groups – saw an Aboriginal doctor at least once after receiving their biomedical diagnosis of diabetes, to seek treatment for symptoms interpreted by the clinic staff as associated with the onset of diabetes and attributed to sorcery actions by both patients and Aboriginal healers.*[34] Aboriginal Australians, Warlpiri, Central Australia, Australia

> *… healing beliefs related to diabetes as more circular and indirect than the linear cause and-effect view of mainstream medicine. Thus diabetes as a process of healing and well-being cannot be separated from spirituality.*[38] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia

Some participants reported a belief in TCIM as an effective treatment and potential cure for diabetes. Some also viewed a colonised diet as a cause of diabetes and sought out traditional foods as part of their traditional medicine and as a means to prevent diabetes and control their blood sugar.

> *… in discussing the importance of a healthful diet, one-quarter of the Native American sample explained that their high prevalence of diabetes resulted from the intrusion of the 'white man's diet' and the loss of native foods …*[45] Native Americans, Great Lakes Indians, US

> *Traditional foods and medicinal plants used to manage diabetes.*[37] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia, Canada

> *33% believed that Indian medicine could cure the disease; 62% indicated that Aboriginal people had their own way of treating diabetes, and that Aboriginal people had medicines that 'worked'.*[40] Canadian Aboriginals, Saskatoon (Plains Cree, Saulteaux, Northern Cree, Metis and Other Nations), Canada

This view was contrasted by some who did not believe it could cure diabetes.

> *In most cases, patients believed that the counter-spells uttered by the healer would alleviate their sufferings but could not remove their diabetes.*[34] Aboriginal Australians, Warlpiri, Central Australia, Australia

> *… significant is the relatively large number of participants (40%) who equivocatingly stated they did not know if Indian medicine could cure diabetes.*[40] Canadian Aboriginals, Saskatoon (Plains Cree, Saulteaux, Northern Cree, Metis and Other Nations), Canada

Others spoke of using TCIM to flush the body out, bringing it back into balance and alleviating symptoms they were experiencing alongside diabetes.

> *… to 'flush' or 'clean' the sugar out of their blood and urine thus bringing the body back into balance… In addition to [conventional diabetes treatments], some people use either water, apple cider vinegar, extracts from the tee tree or old man weed, to flush the sugar out of the body.*[36] Aboriginal Australians, Melbourne, Victoria, Australia

> *… I was really sick. I couldn't keep my food in, couldn't eat or sleep. So I went for some Indian medicine and tried it. I felt better. It must have just washed me out.*[37] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia, Canada

TCIM co-treatment

Participants commonly reported using both conventional and TCIM treatments in parallel for their diabetes. TCIM was often viewed as complementary or supplementary to biomedical approaches rather than as a direct alternative to biomedical approaches.

> *For all of the participants, the use of both western and traditional medicines was commonplace.*[37] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia, Canada

> *Their stories revealed that diabetes is at times treated concomitantly with traditional medicinal, spiritual, and ceremonial purification practices.*[38] Canadian Aboriginals, Nuxalk Nation, Bella Coola Valley, British Columbia

> *… our results corroborate other reports that …* [complementary medicine] *practices may supplement but do not undermine conventional management efforts.*[45] Native Americans, Great Lakes Indians, US

> *… this study uncovered little evidence of the use of traditional medicine to the exclusion of biomedicine…* [they] *used both medical systems in a complementary, not contradictory way.*[40] Canadian Aboriginals, Saskatoon (Plains Cree, Saulteaux, Northern Cree, Metis and Other Nations), Canada

In one study, some younger male participants rejected both conventional diabetes treatment and TCIM treatments altogether:

> *… the youngest diabetic patients (18 and 27 years old) did not want to engage with medical staff or traditional healers. In fact, most rejected the dividends of all healing practices, and young men even more acutely.*[34] Aboriginal Australians, Warlpiri, Central Australia, Australia

Discussion

The findings from this review provide some important insight into the use of TCIM by Indigenous peoples with diabetes in Australia, Canada and the US. There was a distinct lack of clarity in defining TCIM in the included articles. In most cases, there was no definition of what traditional or complementary medicines consisted of in the context of each article. This poses concern when interpreting TCIM use due to the potential for over-estimation of TCIM use, particularly if it is found to be more congruent with mainstream medicine.[47,48] Without clear definition, it is also difficult to assert if TCIM is used for overall wellbeing rather than for specific conditions. Furthermore, one group considered the use of WD-40, a common household item that is intended solely for external use, as a complementary medicine "to relieve joint pain".[41(pS65),42] While the WHO states that TCIM may be "explicable or not"[15] the basis on which WD-40 was deemed a complementary medicine was unclear, nor whether it is safe, efficacious, and therapeutically sound, as is outlined in the WHO's Traditional Medicine Strategy.[15] WD-40 and kerosene both advise against the topical and internal use of these products in their respective Material Safety Data Sheets, and as such there are safety concerns regarding their use as TCIM.[49,50] Lastly, the heterogeneity of Indigenous communities within these countries is reflected in the diversity of their traditional knowledge and medicines, therefore it is not possible to define one Indigenous medicine. This has implications for research where meaningful engagement with the Indigenous communities is paramount to the accurate measurement of TCIM use. Due to the wide variance of TCIM use in the articles and lack of adherence to standard definitions, we were unable to meaningfully compare or quantify the prevalence of TCIM use among Indigenous peoples with diabetes.

Diets imposed on Indigenous peoples as a result of colonisation were seen as a cause of diabetes. Researchers have noted the dramatic increase in lifestyle diseases as a result of these changes in diet and physical activity.[51] Specifically, the westernised diet imposed by colonisation is characterised by energy-dense foods that are lacking in nutrition, such as highly processed foods containing high levels of sugar, trans-fats and salt.[51] Indeed, the participants in the included articles saw this change in diet and physical activity as a reason for their development of diabetes.[45] They saw a return to their traditional foods and medicines as a way to prevent diabetes, and to control blood sugar levels in those who already have diabetes.[36,37,40,45] Researchers have also found that a return to traditional diets improves the health of Indigenous people. One study by O'Dea and colleagues found that a return to the traditional Indigenous Australian diet resulted in marked improvements in lipid metabolism and metabolic syndrome.[52] After seven weeks of consuming their traditional diet, participants lost eight kilograms on average, reduced their fasting plasma insulin levels, decreased their serum triglyceride levels and improved their postprandial glucose clearance.[52] This speaks to the need for clinicians to consider the change in diet and the likelihood of Indigenous people with diabetes willingness to return to their traditional ways of eating, as potentially important to the clinical management of diabetes within this population, and that supporting a return to the traditional way of eating may facilitate positive health outcomes among Indigenous people with diabetes.

Participants in the articles alluded to differing understandings of the aetiology of diabetes and its manifestation in the body, with many people viewing TCIM as working to 'flush' or 'cleanse' the body of sugar. This suggests that participants perceive diabetes as a short-term acute manifestation of symptoms, rather than a chronic condition impacting their lives in the long term. Such views have implications for both conventional and other treatments for diabetes and warrants further investigation. However, these perceptions of diabetes were not explored further in any of the included articles. Addressing this knowledge gap in future research will allow researchers and health practitioners to better

support Indigenous peoples with diabetes, their treatment plans and provide strategies for improved health promotion about the condition.

Our findings indicate that Indigenous peoples with diabetes from Australia, Canada and the US are likely using some form of TCIM alongside their conventional diabetes treatments; this has implications for healthcare providers and systems. First, it is important that healthcare providers working with these populations discuss TCIM use, its safety and its potential to interact with conventional medicine with their patients, as many participants reported using both conventional and TCIM treatments for their diabetes care. Second, it is important that healthcare providers recognise that participating in TCIM activities may provide other non-medicinal benefits to Indigenous peoples with diabetes. TCIM was cited as meeting the participants' cultural, physical, spiritual and psychological needs – needs that were not met by conventional medicine. While these may differ from healthcare providers' personal and professional ideology around what constitutes efficacious treatment for diabetes, research suggests that these factors can contribute to the positive wellbeing of Indigenous peoples.[53] It is also important that healthcare providers acknowledge Indigenous peoples' use of TCIM in the context of Indigenous peoples' holistic and interconnected views of their own health and wellbeing. Understanding this holistic view of health will work towards improvements in the cultural safety and appropriateness of healthcare systems.

Finally, one article with urban Native Americans found those who travelled for more than 60 minutes to access conventional diabetes healthcare were more likely to use herbal medicines than those who only needed to travel for 30 minutes or less,[44] which implies that distance from conventional diabetes care is a driving factor in TCIM use. This is at odds with previous research in the general population that has found TCIM usage, while more prominent the further one gets from the inner city, is driven by cultural factors, not access to conventional diabetes care.[54] Indeed, Grzywacz and colleagues (2006) found Native Americans who had decreased access to over-the-counter medicines were more likely to use home remedies than white people.[42] However ethnic difference in home remedies use persisted even after controlling for structured inequalities, suggesting that cultural explanations are likely to explain these differences in use.[42] Regardless, access to healthcare services and TCIM use must be considered in the context of the COVID-19 pandemic, which has seen an acceleration in the worldwide use of telehealth,[55] eHealth (including mHealth, the use of mobile device applications and functions for health purposes)[56] and other remote models of healthcare delivery.[57] It is crucial that these services have the capacity to provide clear, accurate, and culturally appropriate information regarding safe and effective TCIM use to Indigenous peoples with diabetes as we transition to the future 'new normal' of healthcare delivery.[55,58]

Limitations

The findings of this research were limited by the quality of the articles included in this review; many did not adhere to standard definitions of what comprises TCIM use. Furthermore, articles from New Zealand were not represented in the findings. The majority of participants in the included articles were recruited through health services or health-focused programs, so the findings presented here may not fully represent the views of Indigenous peoples using TCIM to the exclusion of conventional medical treatment.

We recognise that the focus on Indigenous peoples diagnosed with diabetes in Australia, New Zealand, Canada and the US excludes Indigenous populations in other colonised countries and areas around the world. Future research should continue to investigate whether and how other Indigenous peoples with diabetes use TCIM and its impact on their health and wellbeing.

A further limitation of this research is that because of the small number of articles included in the review, not all findings from the meta-aggregation analysis are generalisable or conclusive. For example, the finding that some younger men may reject treatment altogether[34] did not emerge from other articles included in the review and requires further research to ensure this issue is appropriately explored. Findings such as these indicate that TCIM use among Indigenous peoples diagnosed with diabetes is an emerging topic area deserving of increased research attention.

Conclusions

The current review found that the concurrent use of TCIM with conventional diabetes treatment was relatively common for Indigenous peoples from Australia, Canada and the US included in this review. While there was some evidence that Indigenous peoples use traditional medicines to fulfil their cultural, spiritual and emotional needs not met by conventional treatment for diabetes, their understandings of the condition and how it manifests in their daily lives is still an unknown. More research is needed to understand Indigenous peoples' perceptions and understanding of diabetes, their reasons for seeking TCIM, their frequency of TCIM use and what types of TCIM are used. Furthermore, future research should adhere to standard definitions of TCIM use; for example, the WHO definition.[15] This information will help researchers and healthcare providers form a clear picture of this phenomena. Nonetheless, it is important that healthcare providers working with Indigenous peoples with diabetes create a safe space for their patients to disclose any TCIM usage. Indeed, recognising the benefits that Indigenous peoples obtain from using TCIM, which may differ from biomedical definitions, may encourage discussion around its use, ultimately leading to better health outcomes for Indigenous peoples with diabetes.

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