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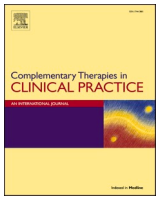

Use of herbal medicines for the management of type 2 diabetes: A systematic review of qualitative studies

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ABSTRACT

Background: Many people with Type 2 Diabetes Mellitus (T2DM) use herbal medicines, some of which can improve glycaemic control. Providing evidence-based advice on herbal medicines could be an effective intervention to improve control of diabetes, if it is designed to address key needs and concerns of T2DM patients.
Aim: To understand the views and experiences of patients and health professionals on herbal treatments for self-management of T2DM.
Method: MEDLINE, EMBASE, CINAHL, SOCIOFILE and Google Scholar were searched for qualitative studies in T2DM patients about their views on herbal medicines. Included papers were analysed using thematic synthesis.
Results: Thirty-one papers (about 30 studies) were included: 20 from low-and-middle income countries, 10 from high income countries, and 1 internet-based study. Almost all studies from high income countries focussed on ethnic minorities. Many people with T2DM wanted a "cure", and often took advice from friends and family, but also traditional healers and mass media. However, they were reluctant to discuss herbal medicines with health professionals, whom they perceived as "closed-minded". They based their treatment decisions on personal experience (from "trial-and-error"), availability, cost and convenience of both herbal and conventional medicines. Most health professionals were reluctant to discuss herbal medicines, or recommended against their use, because of lack of knowledge and concerns about their quality, efficacy and potential interactions.
Conclusion: Evidence-based information could help to overcome the current lack of communication about herbal medicines between people with T2DM and health professionals.

1. Background

Currently, 1 in 11 people globally live with diabetes mellitus, 90 % of which is Type 2 Diabetes Mellitus (T2DM) [1]. This prevalence is predicted to rise over the next decade, particularly as obesity, one of the key risk factors for developing T2DM, is increasing rapidly [2]. Other risk factors include deprivation, ethnicity [3] and family history [4]. Uncontrolled T2DM may lead to lower quality of life, blindness, cardiovascular disease, kidney failure, diabetic neuropathy, amputations, and a lower life expectancy. Current NICE guidelines suggest lifestyle modifications as the first-line management, then oral hypoglycaemic medications or insulin injections depending on severity of the disease [5]. Studies have reported that reversal of T2DM using low-calorie diets and low carbohydrates is possible, but not all patients are able to achieve this [6]. Early initiation of glucose controlling medicines is important for effective control of diabetes when exercise and dietary measures have not helped to control a person's blood sugar levels [7].

Poor adherence to conventional medications leads to poor glycaemic control and hence further microvascular and macrovascular complications of T2DM [8,9]. Poor control of diabetes is more common in patients of ethnic minorities [10,11], leading to an increased risk of morbidity, mortality and disability from complications of T2DM [12]. This may partly be explained by poorer adherence to conventional medicines and lower health literacy [13]. Some patients delay their consultation with a doctor or refrain from taking conventional medicines, despite their high blood glucose levels, due to fears about side effects of medications. For example, anxiety and fear of pain associated with injections discourages approximately 30–50% of patients from initiating insulin [14].

Some ethnic minorities are also more likely to take herbal medicines instead of conventional treatments [15]. Globally, 50–60 % of people with T2DM use some form of complementary therapies along with

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conventional medicines [16–18]. In a UK study, about two-thirds of South Asian participants stated that they used herbal medicines for several conditions, including diabetes [19]. In Morocco, 52 % of diabetic participants said that they used herbal medicines specifically to control glycaemia [20]. Recent evidence suggests that some herbal medicines used in combination with conventional treatment can improve glycaemic control [21]. Therefore, this presents an opportunity for intervening to improve glycaemic control, by providing evidence on which herbal medicines, at which doses, are most effective. By employing qualitative methods of enquiry, our goal is to develop an intervention that provides evidence-based information on herbal medicines for T2DM, for both patients and health professionals.

However, it is not clear how and why some patients choose to use certain herbal medicines alongside or instead of conventional medicines, or whether their use would be acceptable to most patients or mainstream health professionals. It is important to understand this decision-making process, and key issues, needs and challenges, to inform development of an intervention. To date, there has not been a systematic review of this qualitative literature.

2. Aims

- To understand the views of diabetic patients about the use of herbal medicines for self-management, and their reasons for choosing or not choosing herbal remedies exclusively or alongside conventional medicine.
- To explore the views of health professionals about the use of herbal medicines for type 2 diabetes.

3. Methods

The protocol for this review has been published on the PROSPERO database [reference: CRD42022279686 available from https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42022279686].

3.1. Inclusion criteria and search strategy

We searched the following databases from inception to 1st July 2023 for qualitative studies: MEDLINE via Ovid (from 1946), EMBASE via Ovid (from 1974), CINAHL (Cumulated Index to Nursing and Allied Health Literature, from 1990), and SOCIOFILE via ProQuest (from 1984). An extensive search strategy was formulated with broad search terms and MeSH terms for type 2 diabetes, herbal medicines, qualitative studies, attitudes of healthcare professionals and patients. The search strategy (Supplementary Table 1) was adapted for each of these databases to retrieve all the relevant papers. We also searched Google Scholar with the terms herbal, ethnographic and diabetes, which generated around 11,000 results. The first 100 articles in the search were included for screening. Experts in the field were contacted for advice regarding the search strategy. We used the SPIDER framework [22] to describe the inclusion criteria.

- **S**ample – patients with T2DM and healthcare professionals involved in the management of T2DM.
- **P**henomenon of Interest – herbal medicine
- **D**esign – qualitative study design
- **E**valuation – views, beliefs and experiences of patients and healthcare professionals
- **R**esearch type – qualitative analysis

3.2. Screening

Titles and abstracts of papers were screened independently by two reviewers using Rayyan [23], and relevant studies were selected for full-text screening. The full texts of the studies were screened to decide which studies to include. We documented this process using a PRISMA flowchart [24].

We excluded ethnobotanical studies that talked about different herbs used for the treatment of diabetes since they did not explore the views of patients or doctors about their use. We also excluded quantitative studies but included mixed methods studies with significant qualitative data. We excluded studies that explored the use of complementary and alternative medicine (CAM) in general, but did not specify the use of herbal medicines or plant-based therapies. Studies regarding herbal medicines for complications of diabetes (rather than diabetes alone) were also excluded. No language restrictions were applied when papers were screened.

3.3. Quality appraisal

The Critical Appraisal Skills Programme (CASP) tool for qualitative studies, a 10-item checklist, was used to assess the quality of the included studies [25].

3.4. Data extraction and analysis

We extracted data on the characteristics of the included studies. Then two researchers independently drafted a coding framework after reading several articles. This framework was iteratively improved as it was used to code the results and discussion sections of all included papers, using QSR NVivo [26]. The results and discussion sections of the remaining papers were coded using the framework previously created, and additional codes were added when necessary. A summary of codes is provided in Supplementary Table 2.

Analysis was carried out using thematic synthesis [27]. We inductively identified the main descriptive themes regarding views on herbal medicine and non-adherence to modern medicine. Secondary analytic themes were derived from descriptive themes to find interpretations beyond those of the initial studies. These were then organised into decision-making models, for patients and clinicians.

4. Results

4.1. Selection of studies

Database screening yielded 5376 papers, and after removing duplicates, there were 3667 papers. Of the 44 articles eligible for full-text screening, 31 (reporting on 30 studies) were included for qualitative synthesis (Fig. 1) [24]. The most frequent reasons for excluding full text papers were that they used quantitative methods or did not explore views on herbal medicines.

4.2. Characteristics of included studies

All three studies from low-income countries were from Africa [28–30]. Two were conducted in outpatient clinics and one in traditional healers' facilities (Table 1a). One study included patients with T2DM, another included healthcare professionals, and the third study included both.

There were 17 studies from middle-income countries: two from the Caribbean [31,32], five from Africa [33–37] and ten from Asia [38–47] (Table 1b). Most were conducted in primary healthcare clinics or hospitals; only three studies were conducted in the community. Participants included patients (15 studies), conventional healthcare professionals (6 studies) and traditional practitioners (5 studies).

Ten articles (about 9 studies) came from high-income countries: one from the UK [48], six from the USA [49–54], one from Australia [55] and two from Canada [56,57] (Table 1c). Most were conducted in the community; only two were based in health clinics. Nine included patients and only one included healthcare professionals. Most of these recruited participants were from ethnic minority backgrounds. Only one study conducted in Australia explored the views of patients from the

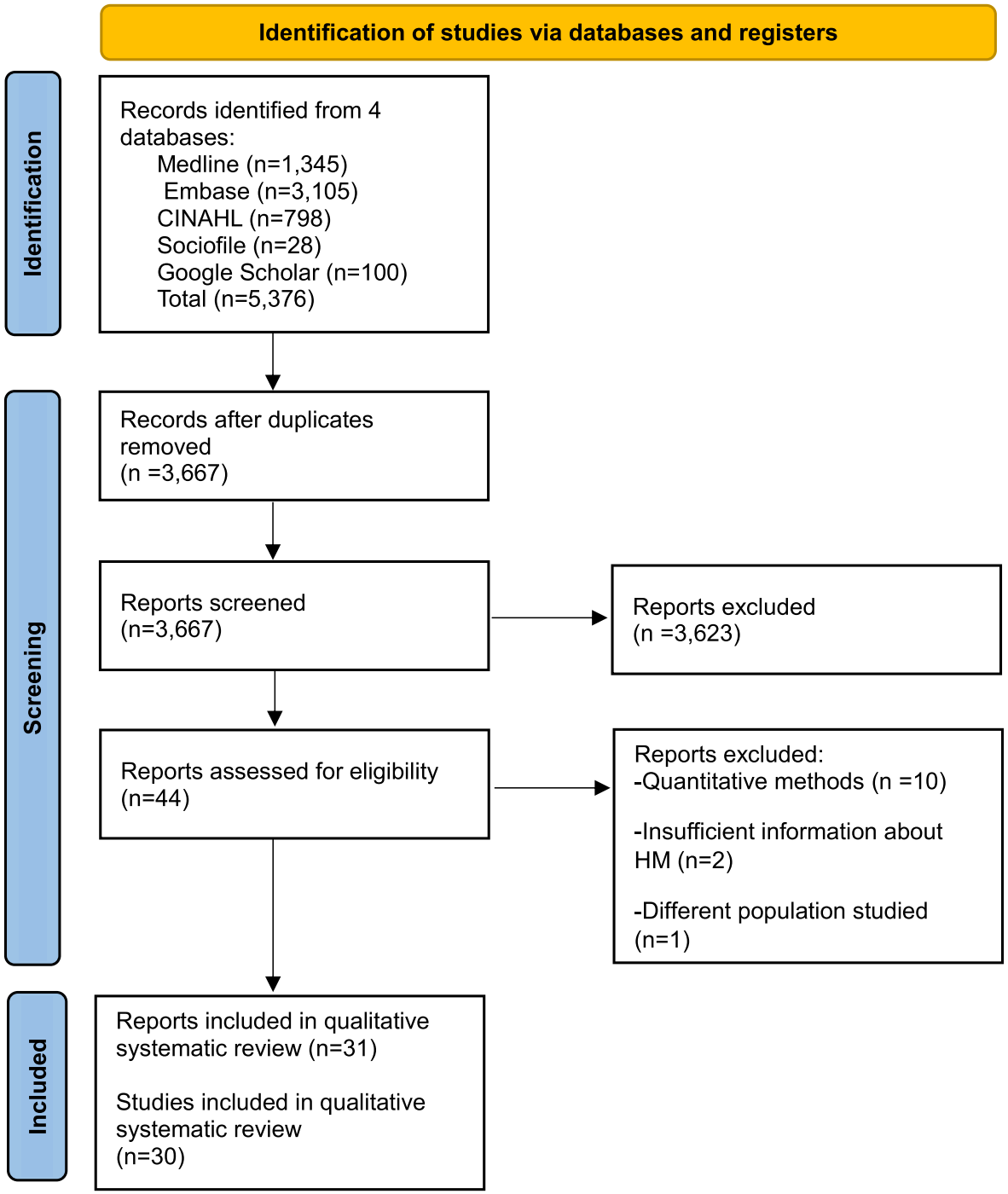

Fig. 1. PRISMA flowchart.

white community [55]. Data was collected using focus group discussions, interviews, and participant observations.

One study was international, conducted using qualitative information from posts on 22 major online forums on the internet, restricted to those written in English, from patients describing and sharing their experiences with herbal and complementary medicines and their effect on T2DM [58] (Table 1d).

4.3. Quality appraisal

All the papers presented valuable evidence (Supplementary Table 3). However, only nine papers considered the relationship between the researcher and participants in their analysis. Eighteen studies recruited participants from diabetic outpatient clinics, who may be less likely than the general population to disclose their use of herbal medicines and/or more likely to believe in conventional therapies. To mitigate this, some researchers employed interviewers who did not work in the hospital to conduct participant interviews and/or allowed for interviews to be conducted outside of the hospital setting [28,33,37,39,49,50]. One study in Cameroon aimed to maximise patient participation in focus group discussions by creating groups with generally the same age, gender, and status [34].

4.4. Data synthesis and development of models

Patients from different countries had varying levels of concern over

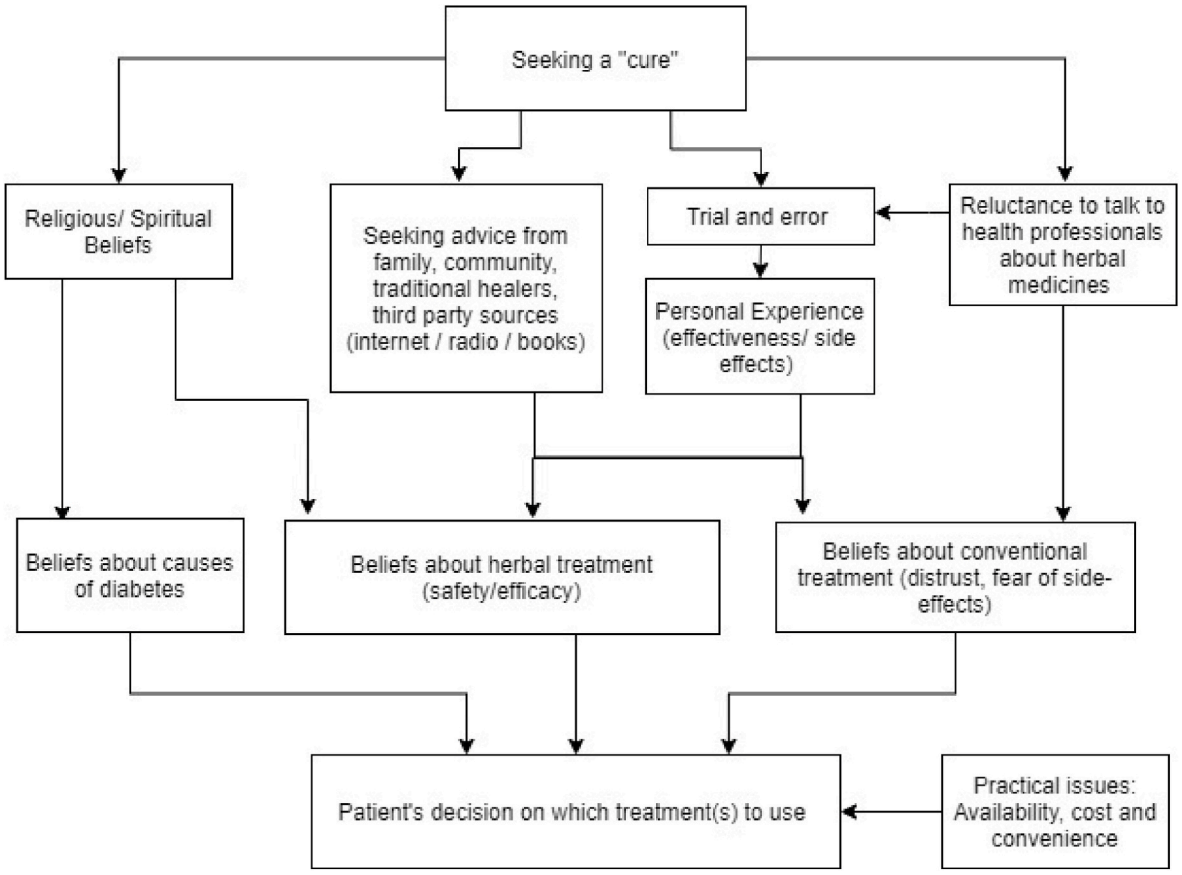

Fig. 2. Influences on Patients' decision-making on which treatment[s] to use.

herbal medications, sought advice from different places, and had contrasting previous experiences with both herbal and conventional medications. They also had conflicting views about the cause of diabetes and the benefits of treatment. Hence, different treatment decisions were made by patients about how to manage T2DM in different contexts.

Clinicians had a similar decision-making process, but the key factors leading to reluctance to discuss herbal medicines included: insufficient levels of knowledge about herbal medicines, doubts about the reliability and quality of herbal medicines, concerns about drug-herb interactions and safety issues. Doubts about safety also led to doctors advising patients to avoid using herbal medicines.

4.5. Influences on patients' decision-making about use of herbal and conventional treatment (see Fig. 2)

4.5.1. Seeking a cure

The ultimate aim for many patients was to find a "cure" for their diabetes. This led them to believe that allopathic treatment is ineffective as it does not offer a "cure".

> *"There is one man in Malindi, I have heard that he prepares herbs for diabetes. There are several people, like ten people, have been cured of diabetes."* – Diabetic patient, Kenya [33].

> *"Diabetes is the silent killer disease. There is no cure from its roots to the allopath science. Many peoples are dies in world by the diabetes and its related ailments. However, Ayurveda and Panchakarma have total cure for these"* – (A thread about Ayurveda), Online internet forum [58].

Some herbalists and "alternative doctors" reinforced this belief by promising to cure diabetes:

> *"An alternative doctor in the television said that this herbal medicine will help cure many diseases"* – Diabetic patient, Thailand [47].

Often, patients in middle-income countries would take herbal medicines accompanied with conventional treatment, in the hope that two methods would be a more powerful treatment than one:

> *"With the hope of my diabetes being cured completely, I take both the drugs prescribed by the doctor and traditional practitioner."* – Diabetic patient, Myanmar [44].

4.5.2. Beliefs about the cause of diabetes

Most studies across middle- and high-income countries described the belief that T2DM is a self-inflicted 'lifestyle' [53] condition caused by a poor diet, such as the use of 'granulated sugar' [46], eating 'starchy foods' [57] and 'drinking beer' [34]. Typically, these patients were also more compliant with the use of conventional medicines. However, other studies cited different beliefs about causes of diabetes.

4.5.2.1. Religious/spiritual/supernatural ideas. Some patients believed in religious or supernatural causes for their diabetes. Typically, these patients favoured spirituality, rituals, prayer, and advice from religious leaders to 'cure' their diabetes instead of conventional or herbal treatments. This belief was upheld by traditional healers, whose practices were taken very seriously by the community of patients.

> *"You are told [by the community] that your ancestors have caused your diabetes"* – Diabetic patient, Cameroon [34].

> "*I think I got it because of my bad karma*" – Diabetic patient, Sri Lanka [38].

Table 1
Characteristics of included studies.

Table 1a. Characteristics of studies from Low-Income countries

Reference	Country	Setting	Participants	Phenomenon of interest	Method of data collection	Type of analysis
Atwine 2015 [28]	Uganda	3 Traditional healers' facilities	People >18 years diagnosed with type 2 diabetes. Females [N = 10] and males [N = 7] aged 39–72 were recruited.	To explore healthcare-seeking behaviour among people with type 2 diabetes, to understand reasons for using therapies offered by traditional healers	Focus group discussions	Thematic analysis
Rutebemberwa 2013 [29]	Uganda	Outpatient clinics of 2 government-owned general hospitals in Iganga and Bugiri districts	Patients with diabetes in FGD [N = 32], health workers [N = 9] and herbalists [from Iganga district] [N = 4].	To explore why patients, use traditional medicine for the treatment of diabetes	Focus group discussions and key informant interviews	Thematic analysis
Meshesha 2020 [30]	Ethiopia	Diabetes clinic – 4 public hospitals - Addis Ababa	Prescribers working in diabetic clinics and who had no previous diagnosis of DM were recruited. N = 8	To identify the commonly used herbal medicines among patients with DM and determine the intensity of combined use of herbal and conventional anti-diabetic medicines.	Semi-structured open-ended interview	Thematic analysis

Table 1b. Characteristics of studies from Middle-Income countries

Reference	Country	Setting	Participants	Phenomenon of interest	Method of data collection	Type of analysis
Adeniyi 2021 [31]	Jamaica	Clinics from 4 parishes in Western Jamaica	Patients >18 years diagnosed with Hypertension and type 2 diabetes. N = 25	The use of CAM, perception of effectiveness of CAM and prescription medication, concurrent use of prescription and CAM, and communication with healthcare professionals regarding medicinal practices.	Focus group discussions	Thematic analysis
Moss 2005 [32]	Saint Vincent and the Grenadines	1 rural health centre in Saint Vincent	Patients diagnosed with type 2 diabetes N = 16	To explore beliefs among T2DM patients regarding their usage of non-prescribable medicines for treating T2DM	In-depth conversations	Thematic Analysis
Awah 2014 [34]	Cameroon	8 Primary health care units, tertiary care diabetes centres and in the community	Patients [N = 20] and their families. More than 200 patients were observed in clinics and in the communities they lived. Traditional healers in the community [N = 10] and diabetes consultants in clinics [N = 24] were observed	To evaluate the understanding of diabetes and examine the implications of these understandings for providing effective patient-centred care in Cameroon	Observations, conversations, interviews, focus group discussions, biographies, case studies and documentary evidence	Thematic analysis
Kasole 2019 [35]	Tanzania	Kilimanjaro Christian Medical Centre in Kilimanjaro and Mount Meru Hospital in Arusha	Diabetic outpatients and local herbalists or traditional medicine vendors. N = 140	To understand patients' and herbalists' practices and perspectives regarding the use of traditional medicines and the role of traditional medicines in the management of diabetes.	Focus group discussions and in-depth interviews	Thematic analysis
Mahomoodally 2016 [36]	Mauritius	Public hospital, private clinic and regional health centres	Dieticians, nutritionists, doctors and nurses. N = 15	To understand healthcare professionals' willingness to recommend Alternative therapies for adjunctive management of diabetes	Questionnaire	Thematic analysis
Abdulrehman 2016 [33]	Kenya	Community - Lamu town	30 participants >18 years with type 2 diabetes	To understand factors that affect diabetes self-management in Swahili culture	Participant observation, field note taking and ethnographic interviewing	Thematic analysis
Parker 2015 [37]	South Africa	Genadendal clinic - Home-based care unit	Participants aged between 40 and 70 years diagnosed with type 2 diabetes who used plant/herbal medicines for their treatment, Key informants included clinical staff, herbalists and care providers. N = 37	To explore the medical knowledge systems and herbal management of type 2 diabetes among individuals in Genadendal as a case study	In-depth and semi structured interviews, observation and material semiotics	Thematic analysis
Oo 2020 [44]	Myanmar	Community - suburban area in Yangon	Participants aged between 40 and 60 years, diagnosed with type 2 diabetes. N = 7	To understand the cultural practices of Bamar diabetic patients in Myanmar	Participant observation, writing field notes ethnographic interviews, reviewing records, writing field notes	Thematic analysis
Chacko 2003 [40]	India	3 hospitals with diabetes treatment facilities in the cities of Cochin and Thrissur – Kerala	Patients with type 2 diabetes >3 years [N = 50]. Physicians trained in biomedical tradition [N = 3] and ayurvedic doctors [N = 2].	To investigate the use of complementary therapies to manage Type 2 diabetes in an urban population in Kerala	Participant observation and in-depth personal interviews	Thematic analysis

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Table 1 (*continued*)

Table 1b. Characteristics of studies from Middle-Income countries

Reference	Country	Setting	Participants	Phenomenon of interest	Method of data collection	Type of analysis
Amarasekara 2014 [38]	Sri Lanka	Colombo South Teaching Hospital/ Family Practice	Key informants aged >18 years diagnosed with T2DM receiving their diabetes care. N = 14	To explore the impact of sociocultural context on glycaemic control behaviours among adults with T2DM in Sri Lanka	Participant observation, field notes, in-depth interviews and a reflective diary of the PI	Thematic analysis by Miles & Huberman [1994]
Pumthong 2015 [45]	Thailand and Laos	Diabetes clinics in hospitals	Practitioners [N=15] and DM patients [N=15] with experiences in using acupuncture, massage, herbalism or exercise for DM treatment.	To explore the complementary or alternative practices used to promote health and reduce complications of patients with DM	Interviews	Thematic analysis
Edussuriya, 2021 [42]	Sri Lanka	Diabetes clinic in a selected hospital	Patients being treated for T2DM for over 1 year and using natural herbs as medicines. Aged 24–75. N = 12	To explore the experiences of patients who are using natural herbal treatments for T2DM	In-depth interviews	Thematic Analysis
Wanchai 2017 [47]	Thailand	Primary healthcare units	People >18 years old, diagnosed with T2DM and had experiences in CAM use. N = 31	Experiences of CAM use among Thai patients with T2DM	Interviews	Thematic analysis - Colaizzi's phenomenological method
Lundberg 2011 [43]	Thailand	Urban Muslim Community living near a university hospital	Women >20 years diagnosed with T2DM that can read and write. N = 29	To describe Thai Muslim women's self-management of type 2 diabetes	Semi-structured interviews and participant observation	Thematic Analysis
Sari 2022 [46]	Indonesia	5 Primary health centres in Central Java	Adults aged >20 years: 36 patients with T2DM, 11 family members and health providers	To explore the cultural beliefs and practices of diabetes self-management	In depth interviews, observations and field notes	Thematic Analysis
Chan 2020 [39]	China	Public and private clinics and teaching hospitals in Hong Kong	21 patients with T2DM, 14 conventional medicine physicians, 15 Chinese medicine physicians	To explore barriers and recommendations regarding service delivery and research of integrative medicine among diabetes patients and physicians	Semi-structured focus group interviews	Thematic Analysis
Chang 2012 [41]	Taiwan	Diabetes clinics at 3 different hospitals	Patients with T2DM who could discuss their experiences related to CAM use and came from diverse backgrounds. N = 16	To explore how people with T2DM who were CAM users made decisions about their use of CAM	Naturistic enquiry - Semi-structured interviews	Thematic analysis

Table 1c. Characteristics of studies from High-Income countries

Reference	Country	Setting	Participants	Phenomenon of interest	Method of data collection	Type of analysis
Porqueddu 2017 [48]	Scotland	Community - Edinburgh	Indian and Pakistani migrants living in Edinburgh who have T2DM. N = 21	To understand Indian and Pakistani migrants' understandings of diabetes, their experiences of the illness and their strategies for managing the disease.	Group discussions and semi-structured interviews	Thematic analysis
Schoenberg 2004 [54]	USA	3 health clinics and 1 senior centre	Participants [African Americans, Hispanics, Native Americans, Rural whites] were >50 years and affected by diabetes. N = 20	To explore the prevalence of CAM use for diabetes self-management among a multiethnic population, understand lay perspectives on CAM's utility and determining whether CAM practices undermine conventional diabetes self-management.	Semi-structured interviews	Thematic analysis
Jones 2006 [53]	USA	Rural communities - central Virginia	Adult participants, ages >21, diagnosed with T2DM, African American. N = 68	To understand the use of CAM therapies and the role of religion and spirituality in dealing with T2DM	Focus group discussions	Thematic analysis
Johnson 2021 [56]	Canada	Sioux Lookout, Ontario	Adult participants aged 35–70. 3 involved in traditional medicine practices, 5 elders, 2 health administrators N = 10	To examine the role traditional medicine plays in diabetes management in First Nation patients	Interviews	Thematic Analysis
Brown 2019 [49] and Brown 2022 [50]	USA	Community - South Florida	Informants aged 44–74 years (migrated from Jamaica) including patients diagnosed with type 2 diabetes. (N = 9) and suppliers of herbal medicines (N=4)	To explore and describe how Jamaican adults who live in South Florida select and use complementary therapies for managing diabetes	In-depth interviews and participant observation	Thematic analysis
Deol 2022 [51]	USA	Sikh temples in Northern California	Asian Indians with type 2 diabetes for at least 6 months aged >18years. N = 12	To understand beliefs and practices about diabetes self-management in first generation Asian Indian Hindus and Sikhs	Interviews	Thematic Analysis
Hunt 2000 [52]	USA	2 public clinics in San Antonio and Laredo	Low-income Mexican Americans with type 2 diabetes N = 43	To explore if alternative treatments by Mexican American patients with diabetes pose a barrier to conventional medical treatment	Interviews	Thematic Analysis

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Table 1 (*continued*)

Table 1c. Characteristics of studies from High-Income countries

Reference	Country	Setting	Participants	Phenomenon of interest	Method of data collection	Type of analysis
Waldram 2000 [57]	Canada	Community - Saskatoon	People with diabetes >18 years. N = 60	To assess the cultural understandings of diabetes and the use of traditional medicine among Aboriginal people with diabetes in Saskatoon	Interviews	Thematic analysis
Warren 2013 [55]	Australia	Community - Victoria	69 People diagnosed with T2DM or CVD who have used CAM for any reason. 20 Healthcare providers experienced in managing T2DM or CVD.	To explore why people under treatment for T2DM and/or cardiovascular disease used CAM therapies; to establish the relationship with adherence to their prescribed medication	In depth Semi-structured interviews	Thematic analysis

Table 1d. Characteristics of internet-based study

Reference	Country	Setting	Participants	Phenomenon of interest	Method of data collection	Type of analysis
Alzahrani 2022 [58]	Worldwide [Internet based]	Online Forums	1156 posts from 22 forums containing 77 threads	To explore the beliefs and experiences of patients in relation to their use of CAM in diabetes via data from online patient forum discussions	Online Forum posts	Thematic analysis

"I believe this disease is a trial from Allah [God] to test whether or not I have patience" – Diabetic patient, Indonesia [46].

4.5.2.2. Diabetes is infectious. One study in Kenya reported the belief that diabetes is infectious, especially in less educated participants. Several believed that diabetes could be transferred through mosquito bites and sexual intercourse. Many of these patients used both oral and herbal medicines for diabetes.

"I was informed yesterday that diabetes is infectious" – Diabetic patient, Kenya [33].

"In our belief, the Swahili say, if a person with diabetes enters the bathroom and urinates, and then you enter the bathroom afterwards, you can get it [diabetes]." – Diabetic patient, Kenya [33].

4.5.3. Advice from others

In their quest for treatment or a "cure", patients tended to seek advice from various sources.

4.5.3.1. Trusted advice from family and community. Many studies reported that family and community members advised patients to try herbal medicines [28,29,31,38,41–43,47–49,52,56,57]. Some even recommended specific herbalists within their communities who were believed to "cure" T2DM [33].

"*My sister also has diabetes mellitus. She always encourages me to add plants and leaves to my diet which are very effective in controlling diabetes mellitus*" – Diabetic patient, Sri Lanka [42].

"My friend suggested me to eat Eurycoma longifolia jack extract [a flowering plant in the family Simaroubaceae]. She said that it can control blood sugar. So I just tried it." – Diabetic patient, Thailand [47].

In addition, communities in Kenya, Indonesia and the US also played a role in reducing patient's trust in conventional medicines [33,46,49]:

"*You don't have to take the doctor's medicine cause it's gonna kill you … that's what they [friends] told me*" – Diabetic patient, US [49].

4.5.3.2. Advice from mass media. The internet, radio and books have increasingly become sources of information for patients to learn about 'at-home' herbal remedies to help manage their diabetes [28,41,42,47,49,53,58]:

"Many participants mentioned that 'Fragrant-toon tea [香椿, Toona sinensis Roem]' is frequently promoted on TV. [One patient] stated 'the Internet and TV all talked about it" Researchers in Taiwan [41].

Whilst most patients agreed that these herbal remedies were only to a 'give it a try' [58], some patients in Thailand were convinced by radio DJs on television that herbs 'can cure diabetes' [47]. Notably, only one study reported a patient's mistrust of information online, who did not improve after trying cinnamon, which they read online could lower their blood sugar [58].

4.5.3.3. Reluctance to discuss herbal medicines with health professionals. Many studies reported that patients did not discuss herbal medicines with health professionals [31,47–49,55], even in settings like China, India and Thailand where there are well-established traditional systems of medicine [39–41,47]. Sometimes, this was simply because the doctor did not ask whether they took herbal medication [47]. Others felt they did not want to "*waste the doctor's time*" in discussing alternative therapies [55]. More often, patients perceived their doctors to be *'closed--minded', 'not very amenable to that type of (practice)'* and likely to *'poo-poo it' (disapprove).'* [31,48,49,55]. This was reinforced when patients were told to avoid using herbs due to concerns over their potential interactions with conventional medications [53]. Some believed doctors may not understand the cultural or religious reasons for their preferences [31,47,55], or simply did not know enough about herbal medicine [39].

"I'm not discussing any herbs with the doctor because when you tell him about herbs he says 'nonsense', 'foolishness' so I continue to drink the herb. I put the medication aside for a while, go on the herb, and then back to the medication."- Diabetic patient, Western Jamaica [31].

"*They* (conventional physicians) *do not know which Chinese Medicine physician you consulted and do not know what Chinese medicine you have taken. How can they give an answer?*" (Patient with type 2 diabetes, Hong Kong) [39].

Only three studies reported doctors recommending herbal medicines to patients [28,31,47]. In Thailand, some doctors advised use of herbal remedies alongside conventional medicines to control blood sugar [47]. In Jamaica, some patients were comfortable discussing herbal medication with their doctor from a similar ethnic background; they also felt safe knowing that their doctor could employ both conventional and herbal techniques to lower their blood sugar [31].

"My doctor is a Nigerian that supports both herbs and medication. I would love my Nigerian doctor to give me the herbs because I know he has

an herb book and he knows which ones are best so I can get a list."- Diabetic patient, Jamaica [31].

A few patients consulted other health professionals, such as dieticians and nutritionists, who appeared to be more comfortable in discussing different types of herbal remedies for T2DM management with patients.

"*My mother always asks us to eat green leaves as her nutritionist had recommended her to eat them more often"* - Diabetic patient, Sri Lanka [42].

4.5.4. Beliefs about herbal medicine

4.5.4.1. Religious/spiritual/historical beliefs. Herbs have been part of some religious practices to manage T2DM [31,32,56]. Some patients believed that such herbal treatments were sacred, and placed on Earth by God for humans to use as healing treatments [31,49]:

"*Herbal comes from my religion. The Seventh-day Adventist, the prophetess, Ellen, tells us that herbs are good for the body*" - Diabetic patient, Jamaica [31].

Spiritual beliefs were also helpful to many patients as a 'coping mechanism' for dealing with the complications of their T2DM whilst using conventional and herbal medicines [41,53]. Others believed that God provided the knowledge of treating diseases to doctors, and so conventional medicines were as trusted as herbal medicines [53]. In contrast, two African American patients from the same study stated that some members of the community did not trust conventional or herbal medicines and would rely solely on prayer to 'cure' their T2DM, due to the belief that God might help them more than doctors can.

"*Too many people … would stay away from the doctor; I mean, in this neighbourhood, in some areas, there may be some religions that would say, you can pray this [diabetes] away."* - African American diabetic patient, USA [53].

Some patients highlighted the issue of historical racism against African American patients in the medical system. They emphasised that whilst prayer was important in their lives, the inclusion of conventional treatments and modern science in their healthcare had been revolutionary:

"We pray to God and things, but then, too, we seek prayer to the medical science for the knowledge that they have for coming up with medicine that we can use to, not to cure our complaint, but to actually live with it, which you couldn't do years ago [because] you didn't have the medicine. We [African Americans] couldn't get the medicines we have today." - African American diabetic patient, USA [53].

4.5.4.2. Lack of knowledge of herbal treatment. Four studies described a loss of herbal knowledge from previous to current family generations [49,50,52,56], which made it more difficult to select the correct herbs to treat diabetes. Patients who sought herbs from traditional healers did not know which specific herbs they had been given, which made it more difficult for them to discuss their herbal medicine usage with health professionals [28,39]. Other patients called for more evidence on the efficacy of herbal medicines before making the decision to use them:

"I think more research should be done in the herbal area" Diabetic patient, Jamaica [31]

4.5.4.3. Views on safety and quality of herbal treatment/traditional healers. All studies reported the prevalent view among patients that herbs are safe, 'pure' [31] and 'natural' [38], although one patient from Thailand suggested that '*taking herbs may destroy your kidney*' [47]. In higher-income countries, patients and health professionals explicitly expressed concerns about drug-herb interactions, whilst others feared that using both together could corrode the liver [49,52].

"I did not use the same time with the medicines because I did not want to corrode the liver" - Jamaican diabetic patient, USA [48].

However, some patients expressed concerns about the variable standard of herbalists that are prescribing alternative therapies:

'Today, specialists in Ayurveda range from those with a Bachelor's degree in Ayurvedic medicine to local vaidyans, Ayurvedic doctors with no formal training.' - Researchers' interpretation, India [40].

4.5.4.4. 'Trial and error' of herbal medications. Many patients in different countries, and across all economic categories, opted to trial herbal medicine for its potential benefits, with varying reasons for doing so. Three diabetic patients in Australia highlighted that their 'trial' of herbal medications was a sign of their autonomy, with one stating:

"it's my body and I do have to try things out" - Diabetic patient, Australia [55].

Others tried several treatments in the hopes of lowering their blood sugar levels:

"Oh God, I mix them up. I, I, I, was trying everything all the time. And sometimes I feel like I was overdoing it, cause as you just asked if I did it one at a time. I just did every bloody thing to see if I could lower this sugar" - Diabetic patient, USA [49].

Patients in the US suggested that herbal medicines work for some, but not for others, so they tried herbs for a short period to assess their potential efficacy [49,50]:

"Different people have different response. It depends on how your body reacts" – Jamaican American diabetic patient, USA [49].

4.5.4.5. Personal experience of herbal medicines. Personal experience through trial and error was a key factor in a patient's decision to continue using herbal medicines. Many studies in low income countries (Uganda [28]), Middle income countries (Jamaica [31], Kenya [33], Taiwan [41], Sri Lanka [37,42], Thailand [43,45,47], Mauritius [36], Tanzania [35], Indonesia [46]), high income countries (US [49,50]) and online internet forums [58] reported that patients perceived herbal medicines to be effective in lowering blood sugar. Some experienced side-effects which they interpreted as being due to a significant reduction in blood sugar:

"I used to drink kothalahimbatu [Salacia reticulata] once per day. Then I experienced faintishness and vertigo. So, it was clear for me that these natural herbs definitely reduced my blood glucose level" - Diabetic patient, Sri Lanka [42].

"Soursop leaves are good for managing diabetes, but one has to drink only very little because if you drink too much, your blood sugar drops and becomes extremely low. One day I used it and I immediately experienced side effects" - Diabetic patient, Tanzania [35].

Some patients reported that they used herbal remedies to reduce blood sugar in periods of hyperglycaemia:

"I tell you from this experience, in emergency taking guava leaves and chewing them two or three times a day if you feel that blood sugar is high, and it will go down." – Diabetic patient, Uganda [28].

Other patients opted for herbal medicines to improve their general health:

"After I take this herbal tea, I feel my body get healthier" – Diabetic patient, Indonesia [46].

On the other hand, some patients in Thailand found the use of herbs

to be ineffective, with no reduction in blood sugar levels [47]. This sentiment was echoed by patients in China suggesting that the results of herbal trials were not reproducible, and different remedies act on patients' bodies differently [41]. One US study reported that patients would change herbal medicines when they felt that they were no longer working:

> "*After six months, it [periwinkle] didn't work anymore. Same thing with the cerasee [Momordica charantia], you shouldn't use it continuously; it's good to switch because if you use the one thing over it masks the sugar.*" - Diabetic patient, USA [50].

One patient regretted their decision to trust herbalists and rely on herbal medicines, as they did not work to reduce their blood glucose, which led them to end up in hospital:

> *"I am now admitted in the hospital because I absconded from hospital medicine and went for herbs. The worst situation is that the herbalist stops you from taking hospital medicine and gives you hope that herbs cure diabetes; herbs do not treat diabetes."* – Diabetic patient, Uganda [29]

Many studies reported that participants did not experience any side effects from herbal medicines [36,38,40,48,51,52,58]. Only one study (in Taiwan) reported that patients discontinued CAM because of side-effects [41].

Smell and taste were key factors in patients' experience of herbal medicine. Whilst one diabetic patient in South Africa found the scent of herbs 'therapeutic' [37], several struggled to use herbal medicines long-term, with one Jamaican patient residing in the US citing reasons such as 'I can't really stand the smell' [49], and others not using specific therapies because they disliked the flavour [41,49].

4.5.5. Beliefs about conventional treatment

4.5.5.1. Distrust. Several studies reported a distrust in conventional medicine. For example, a patient from the US discovered information online about a conventional drug that was undergoing a lawsuit. The patient discussed this with their doctor, who then advised to stop taking the medication.

> "*I saw there was a class action ahm lawsuit about the drug … So I came in to the doctor and he said 'well you don't have to use it anymore', so, that's telling me that, you know ahm, some of these drugs are experimental.*" - Diabetic patient, USA [49].

4.5.5.2. Poor knowledge about conventional treatment / lifestyle. Many studies reported that patients were unaware of how conventional therapies worked and altered the doses based on what they believed was effective. For instance, a study in Edinburgh revealed that patients reduced their doses when they felt that they were taking too many tablets [48]. Many patients were also unaware of the importance of lifestyle measures in managing their diabetes. Some studies reported that people found it difficult to make changes to their diet due to cultural reasons and not wanting to change their usual food preferences [38].

> *"As my doctor prescribed, I take medicine. Although the doctor asked me to take the medicine before meals, I take it with food. I think it would be more effective."*- Diabetic patient, Myanmar [44].

4.5.5.3. Fear of side-effects. Several studies reported that some patients disliked taking allopathic tablets due to their chemical nature, perceived side effects, fears of dependence, beliefs about causes of diabetes, and dislike of following a strict diet while taking tablets to maintain their blood sugar. Some patients considered tablets to be ineffective since they were not completely cured of diabetes after taking them.

> *"When they prescribe me pharmaceutical drugs, I refuse, because I have heard that once you are used to the medicine, you have to take them every day."*- Diabetic patient, Kenya [33].

> "*I heard that these tablets damage the kidneys. So, I am very afraid … I don't take it as my doctor told me."* - Female patient, Sri Lanka [38].

In Indonesia, patients believed that insulin was a cause of imminent death from previous experiences of seeing neighbours pass away shortly after starting insulin therapy [46].

> *"I have been working for long time here [in a health center], and I can say that all diabetic patients here believe that insulin will cause dependence and destruction of the body. They refuse when we suggest they use it. This belief has been rooted for a long time"* - Health worker, Indonesia [46].

4.5.5.4. Personal experience of conventional medicines. Only one study reported a patient speaking about their personal experience of conventional medicine effectively lowering blood sugar [31]. Several studies reported experiences of perceived side effects from conventional medicines, more so than with herbal medicines [28,45,47–49]:

> *"I used to vomit, lose appetite, get hungry and feel as if I was going to die; there was no effect [on blood sugar] at all"* – Diabetic patient, Uganda [28].

> "*I believe the herb is coming from the spiritual background; the medication the doctor gives is not as effective. I discovered that even the medication slows down your sex organ and the herb uplifts it.*" – Diabetic patient, Jamaica [31].

> *"After taking the conventional medicines, I feel palpitations in my chest"* - Diabetic patient, Thailand [46].

> *"The Metformin gave me cramps in the stomach and diarrhoea."* - Jamaican American patient, USA [49].

4.5.6. Availability, cost, convenience of herbal and modern medicines

Patients in low- and middle-income countries often found that herbal medicines were cheaper and more readily available than conventional medicines [29,35,42,44,45,48].

> *"I bought natural herbs from herbal pharmacy. It is very cheap. Herbalist is a very kind person. He prescribed several herbs for diabetes and the preparation of these medicines are also very easy"* - Diabetic patient, Sri Lanka [42].

One patient appreciated the convenience of plant-based medications in contrast to the restrictions that were placed on them by diabetic clinics:

> *"[My] Ayurveda doctor told me [about] many kinds of vegetables I can eat and she did not tell me do not eat this and that, not much restriction like the diabetic clinic."*- Diabetic patient, Sri Lanka [38]

Some patients in Kenya and Uganda used herbal medicines as they couldn't afford conventional medicines, or even to pay for transport to the hospital [29,33]. In Uganda, traditional healers were willing to take payment in instalments, whereas doctors required payment upfront, so patients chose herbal medicine until they could save enough money to pay for conventional treatment [29]. In contrast, in high-income countries, herbal remedies were harder to find, and conventional medicines were often cheaper [54].

> *"Up here it's hard to find nopales [cactus] and all this stuff"* - Diabetic patient, USA [54]

> "*When I needed diabetes meds, I considered it, but cost kept me away. My metformin was only $1.99 for a 3-month supply" [A thread about herbal medicine].* – Diabetic patient in online forum [58].

Some patients would run out of conventional medication and then turn to home treatments until they could replenish their supplies:

"What do you do if you don't have access to medications? I still had some medications from India – they finished and then I would eat bitter melons every day." - Asian patient with T2DM, USA [51].

However, in some high-income settings (such as Hong Kong), herbal medicine was much more expensive than conventional medicine, which was a major barrier [39]. Chinese Medicine practitioners also followed up patients much more frequently than conventional doctors, which patients found inconvenient [39].

4.6. Influences on clinicians' advice about use of herbal medicines

Most studies reported that health professionals were reluctant to even discuss herbal treatments, with many citing concerns over safety, quality of herbs and herbalists, lack of research, drug-herb interactions and doubts about their effectiveness (Fig. 3). Doctors in Ethiopia [30] and China [39] emphasised that they had not studied herbal medicines in medical school, and so were not aware of their mechanisms of action. When patients asked questions about herbals, the professionals' default response would be to avoid using them, in order to avoid risk.

"I personally do not believe in using herbal medicines only for management of diabetes. Diabetes is poorly controlled in AT users. Patients are fooled to believe herbal medicines can help." - Doctor, Mauritius [36].

"As a doctor, I have no idea about the real physiological effects of these products. If I do recommend them, that would imply that I should be responsible to answer to any question and doubt of my patients."- Doctor, Mauritius [36]

"I am worried that complementary medicines [do] not have investigations." – Doctor, China [39].

"I advise them [patients] not to take Complementary medicine as I do not know the interaction between Complementary and Conventional medicines." - Doctor, China [39].

Claims that herbal medicines could cure diabetes only increased doctors' scepticism.

"The reason patients with diabetes give is that this biomedical treatment doesn't cure and the traditional healers always promise to cure them. So whenever they meet the herbalists, herbalists deceive them a lot that they abandon biomedical treatment and resort to herbal medicine." - Health worker, Uganda [29].

To encourage patients to continue their conventional medication, some health workers allowed patients to take herbs alongside their treatment. However, they raised concerns about the lack of regulations and dosage instructions for herbal medicines [29].

In contrast, one study in Mauritius reported that nutritionists and dieticians appeared to be confident in providing advice on herbal and alternative therapies to patients and had scientific knowledge on their mechanisms of action:

"Yes, its [herbal] efficacy has been proven in clinical trials. Moreover, substantial research is carried out in this field." – Nutritionist in Mauritius [36].

5. Discussion

5.1. Summary of main findings

Most studies have investigated the views of patients in middle-income countries and in ethnic minority populations in high-income countries. Very few studies investigated the views of white patient populations, so we could not evaluate whether certain views were more prevalent in patients of particular ethnic backgrounds. Only a few studies explored the views of both patients and healthcare professionals [29,30,36,39,46]. Across all studies, patients seemed open to the idea of using herbal medicines for the management of T2DM. Their decisions were based on some key factors: the quest for a "cure", taking advice from family and friends, religious beliefs, beliefs about the causes of diabetes, personal experiences of treatment (often as a result of "trial and error"), beliefs about herbal and conventional treatments, and practical issues. Patients from higher income countries appeared to be more sceptical on the use of herbal medications but were willing to try them. Patients were hesitant to discuss the use of herbal medicine with health professionals. These views seemed to be common across all ages,

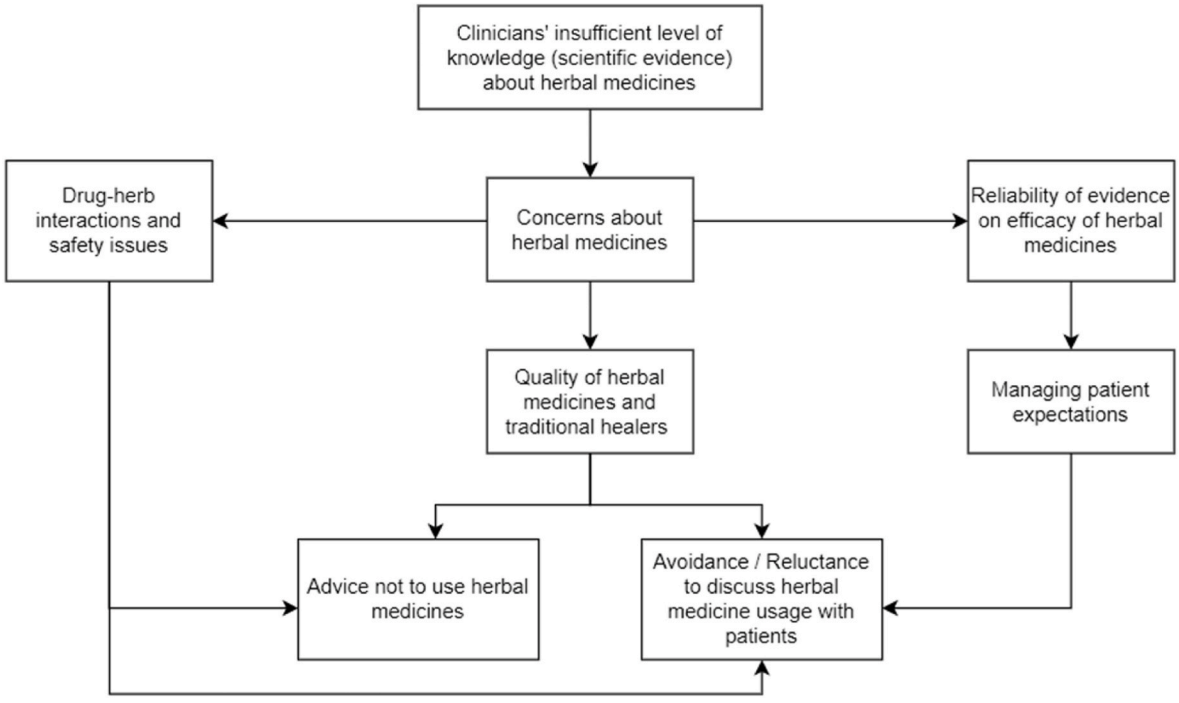

Fig. 3. Clinicians' decision-making model on the use of herbal medicines.

sexes and ethnic groups included in the studies. However, only a few studies mentioned the sex of participants, and most did not specify their age. While most health professionals were reluctant to discuss herbal treatments, some nutritionists and dietitians were more knowledgeable about herbal medicines and were more comfortable to discuss them with patients.

5.2. Comparison with existing literature

A systematic review of 38 surveys in 25 countries has confirmed that complementary and alternative medicine use (CAM) for T2DM is common (prevalence ranges from 17 % in Jordan to 89 % in India) [18]. The most commonly mentioned type of CAM is herbal medicine, of which the most frequently used are Fenugreek, Cinnamon, Garlic, *Aloe vera* and *Nigella sativa* seed [18,20,59–61]. *Aloe vera*, Fenugreek and *Nigella sativa* have demonstrated effectiveness for glycaemic control in randomised controlled trials [62]. In Nigeria, 81 % of patients used herbal medicines to improve their blood glucose control, while 19 % were using it for complications such as neuropathy; 46 % hoped that the herbal medicines could "cure" their diabetes [59].

Of patients who use CAM for diabetes, 78–88 % use it in addition to conventional treatment [18,59]. However, 67–90 % of patients do not disclose their CAM usage to health professionals [18,59–61]. The most common reasons given by patients were that the doctor did not ask them, and they felt it was not necessary to inform the doctor about the herbs they were using [59,60]. In contrast, 66 % of doctors in Saudi Arabia reported that they routinely asked patients about use of herbs, mainly to avoid side-effects and interactions. However, 70 % of doctors thought that very few patients (<25 %) were using herbal medicines [60]; only 26.7 % recommended herbs to diabetic patients based on scientific information, and 31.4 % would refer diabetic patients to a herbal medicine clinic if it were available [60]. Surveys in Nigeria, Saudi Arabia and Egypt revealed that recommendation of herbs from family and friends (45.6 %, 50.6 % and 59.2 % respectively) was the most common source of information, which was corroborated in our study [60,61].

Our study is the first to synthesise the views of T2DM patients from all over the world on their reasons for using herbal medicines. A previous review has explored patients' views on herbal medicine for acute respiratory infections and found that many similar factors influenced their decisions [63]. In particular, both patients and health professionals need trustworthy, evidence-based advice on herbal medicines. However, this review found important additional issues in patients' treatment decisions for T2DM, namely the quest for a "cure" (which is less realistic in diabetes than in acute infections), the importance of religious and spiritual beliefs, and patients using "trial and error" with different treatments.

5.3. Strengths and limitations

A comprehensive search strategy was used to find relevant literature. The focus on qualitative literature yielded a deeper understanding of patients' and healthcare professionals' perspectives. The data analysis process was rigorously carried out. Two reviewers independently coded the first papers and then mutually agreed on a coding framework that was used to code the rest of the papers. Our study reports the views of both patients and doctors, thus revealing gaps in doctor-patient communication. One limitation is that we could have looked at the grey literature and screened more databases, including in other languages like Chinese.

5.4. Implications for clinical practice

Knowledge about patients using alternative medicine can be helpful to doctors involved in their treatment [29]. However, many patients do not discuss their use of herbal/alternative medicines in consultations because they think doctors may not agree or may not understand their reasons for using them. Negativity from healthcare professionals could result in patients simply ignoring their advice, not adhering to standard medicine and / or using herbal medicines alongside conventional medicines [31].

Although many herbal medicines have been proven to have therapeutic effects [62], most health professionals are unaware of this evidence and are unable to advise their patients on the most effective herbal medicines. Both health professionals and patients need better evidence-based information on the effectiveness of different herbal medicines for diabetes, as well as the optimal doses and preparations, in order to promote more open dialogue about use of herbal medicines and choice of the safest and most effective options.

Alongside this information, it is important to make patients aware that neither herbal nor conventional medicines can "cure" diabetes, but that drug-free remission is achievable through radical lifestyle changes such as low carbohydrate diets [64].

5.5. Priorities for future research

As several studies show that many T2DM patients like to use herbal medicines, the results from this review can be used to plan and design an intervention to provide them with evidence-based advice about safe and effective options. The person-based approach [65] could be used to optimise the intervention according to feedback from patients and practitioners. This intervention can then be piloted and studied in a trial, to determine whether providing patients with more holistic options could improve self-management and adherence to treatment, and thus improve control of T2DM.

6. Conclusions

Some patients with T2DM choose to use herbal medicines because of their religious beliefs, advice from family and friends, their beliefs about the causes of diabetes and their personal experiences of using herbal and conventional medicines, as well as practical issues such as cost and availability. Most do not discuss this with health professionals because they think they will get a negative reaction, and most health professionals are reluctant to discuss herbal medicines for diabetes because they have insufficient knowledge about their safety and efficacy, as well as concerns about quality. Evidence-based information on herbal medicines for diabetes could help both patients and doctors to communicate more openly about self-management of diabetes.

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Declarations of interest

No competing interests to declare.

CRediT authorship contribution statement

Shraddha Sriraman: Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Devika Sreejith:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Roles, Writing – original draft. **Evie Andrew:** Data curation, Investigation, Writing – review & editing. **Immaculate Okello:** Data curation, Investigation, Writing – review & editing. **Merlin Willcox:** Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – review & editing.

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Appendix A. Supplementary data

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