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Review article

Importance of phytotherapy for oral health care and quality of life in adults: A scoping review

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Received 10 December 2023; Final revision received 2 January 2024

Available online 24 January 2024

KEYWORDS

Herbal medicines;
Medicinal plants;
Oral health;
Phytotherapy;
Quality of life

Abstract Medicinal plants and herbal medicines are used as integrative and complementary practices to provide comprehensive care, disease prevention, health promotion, and to improve quality of life (QoL). This scoping review aimed to identify and describe the use of phytotherapy in oral health care by adults and their outcomes, with a focus on perceptions of oral health-related QoL, healthcare access, and costs. A systematic search was conducted in six databases and supplemented in grey literature. According to a PRISMA-ScR protocol and eligibility criteria, publications were assessed for final inclusion, data charting, and narrative synthesis. Out of 4124 records, 542 publications were selected for full-text reading. A total of 32 studies were included: 21 studies assessed QoL, 7 reported access issues, and 11 reported costs issues. Herbal mouthwashes to prevent or treat non-infectious oral conditions were the most frequent treatment. Efficacy of phytotherapy was usually better than placebo or control treatment. Most studies reported QoL improvement, but several instruments were used with heterogeneous results. Limited healthcare access and high costs favoured traditional folk herbal medicine in underserved populations. It can be concluded that phytotherapy for oral health is used by adults worldwide, following modern clinical pharmacology and traditional knowledge concepts. Further studies should incorporate assessment of QoL, access, and costs in addition to clinical efficacy and safety, which are complementary aspects for delivering a comprehensive and efficient health care for all people.

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Introduction

Public health policies have advocated phytotherapy, *i.e.*, the use of medicinal plants and herbal medicines, within integrative and complementary practices to provide comprehensive care, disease prevention, health promotion and maintenance, as well as to improve quality of life (QoL), especially in chronic conditions.¹ Oral health is an integral part of human health, reduces the burden of noncommunicable diseases, and improves QoL, well-being, and socioeconomic productivity over the life course.^{2,3} In this context, the rational use of phytotherapy can be a valuable resource for oral health care. However, robust evidence on treatment effect still is limited beyond basic science research, and preclinical and clinical studies are heterogeneous in research design and strength of findings.^{4–8} Moreover, the literature is unclear about how and why adults use phytotherapy for oral health, what they value, and how they perceive its benefits and problems.

A primary requisite is to understand the different conceptual boundaries between traditional knowledge-based use of herbal medicines and professional prescription grounded on clinical physiology and pharmacology. They have different premises to treat either a specific condition (in clinical pharmacology) or the patient from a holistic perspective (in traditional medicine), although both approaches can be complementary. In addition, as traditional medicine relies on ancestral community knowledge, sociocultural and religious aspects can integrate the care and healing of common ailments.^{9,10} The adopted concept will guide diagnosis and treatment; thus, direct comparisons of interventions and outcomes may not be straightforward.

Accordingly, the clinical comparison of different phytotherapy concepts poses methodological challenges. For example, conventional evidence-based methods are not fully applicable to traditional Chinese medicine, which uses a complex knowledge system to deliver a personalized, holistic, and dynamically adjusted treatment.¹¹ Conversely, research in dentistry has focused on phytotherapy efficacy for one specific condition, such as periodontal disease, oral mucositis, or burning mouth syndrome.^{7,8,12,13} Nevertheless, clinical studies should include patient-centred outcomes, such as QoL, perceptions, and values. It is also important to balance phytotherapy in relation to access to health care and costs of herbal medicines *versus* synthetic drugs, considering the global, regional, and local differences in biodiversity, income, and culture.

Therefore, there is a need to answer several broad questions on phytotherapy for oral health and to investigate the nature and key characteristics of publications. As this topic cannot be studied through a single focused question, a scoping review approach was chosen.¹⁴ This scoping review aimed to describe the use of phytotherapy by adults and their perception of value in oral health care with a focus on QoL, healthcare access, and costs, as well as to identify the main knowledge trends, needs, and limitations to guide future research, policy, and practice.

Materials and methods

The review protocol followed the Joanna Briggs Institute (JBI) guidance for scoping reviews¹⁵ and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).¹⁶ The protocol was registered in the Open Science Framework (OSF Registries, doi: <https://doi.org/10.17605/OSF.IO/PF5WD>).

The primary guiding question was: “How is the use of phytotherapy inserted and valued in oral health care and QoL in adult populations?”. The secondary questions were.

- “In which geographic-cultural and oral healthcare context has phytotherapy been used?”
- “Is there any benefit or disadvantage of phytotherapy for oral health from the perspective of patients and practitioners, including healthcare access and costs?”
- “How has QoL been studied in relation to phytotherapy?”
- “Which are the gaps, limitations, and difficulties for research, policy, and practice?”

Eligibility criteria

Eligibility criteria were based on the research questions. To be included, publications had to measure or focus on the dimensions of the conceptual framework ‘Population, Concept, Context’ (PCC): *P* - Adults, including oral health patients and providers; *C* - Framework of phytotherapy (traditional medicine, clinical pharmacology), including people’s values and perceptions, healthcare access, and costs; and *C* - Evidence from oral healthcare delivery and policy, including sources from any geographical location and setting. Eligible information sources included observational studies, clinical studies, qualitative studies, and reviews. *In vitro* and pre-clinical studies, case reports, case series, books, thesis, conference abstracts, editorials, and letters were excluded.

Search strategy and selection process

A search strategy based on the JBI guidance¹⁵ was developed with the collaboration of a senior librarian of the dental school, who performed the bibliographic databases search. The initial search strategy included Medical Subject Headings (MeSH) and free terms in PubMed MEDLINE (see [Supplementary Table S1](#)). The search strategy was adapted to the other databases, and the reference lists of included papers and ‘PubMed similar articles’ were searched to identify further information sources.

Six databases were searched in November 2022, with no restriction of date or language: PubMed MEDLINE (updated search in February 2023), Web of Science, Scopus, Embase, SciELO, and BIREME. Grey literature was searched in Google Scholar. Search results were exported into the Rayyan web app (<http://rayyan.qcri.org>) and deduplicated. Two reviewers (RSAS and CLA) independently screened the titles and abstracts to identify eligible records. Any uncertainty or conflict was resolved by consensus. The publications that met the inclusion criteria were obtained for full-text assessment for final inclusion.

Data charting and synthesis

Data were extracted by one reviewer (RSAS) and revised by a second reviewer (CLA) with customized templates to capture key information on general study characteristics (authors and year of publication, study design, sample characteristics, country of study, healthcare setting, study aim, and phytotherapy concept) and on specific review questions (oral health conditions, phytotherapy posology, outcome measures, healthcare access, and costs). Narrative synthesis and reporting followed the PRISMA-ScR¹⁶ and the JBI guidance.¹⁵

Results

Selection of sources of evidence

The systematic search yielded 4124 records. After removing duplicates, 3940 records were screened for titles and abstracts, resulting in 542 publications selected for full-text analysis. Thirty publications were included according to the eligibility criteria, and two papers were further included after screening the reference lists and the 'PubMed similar articles'. A total of 32 publications^{17–48} were included for data charting and synthesis (the PRISMA flowchart is depicted in the [Supplementary Fig. 1](#)).

Characteristics of sources of evidence

[Table 1](#) summarizes the general characteristics of the included publications (see [Table S2](#) for detailed characteristics). All 32 studies^{17–48} were papers published in peer-reviewed journals between 2004 and 2022 (two 2023 papers were published online in 2022). Study designs included randomized clinical trial (n = 14),^{17–19,22,25,26,28,30,32,33,35,37,40,48} controlled clinical trial (n = 1),⁴⁶ observational clinical study (n = 2),^{38,39} cross-sectional survey (n = 8),^{20,21,23,27,29,31,43,44} qualitative study (n = 3),^{24,36,41} narrative review (n = 2),^{34,45} and systematic review (n = 2).^{42,47} Sample size of the clinical, observational, and qualitative studies varied between 14 and 419 participants.

Participants of clinical studies had several oral health conditions: head-and-neck cancer, recurrent aphthous stomatitis, symptomatic oral lichen planus, Sjögren's syndrome, chemo/radiotherapy-induced oral mucositis, burning mouth syndrome, xerostomia, hyposalivation, temporomandibular joint arthralgia and osteoarthritis, chemotherapy-induced taste disorder, orofacial pain, or third molar surgery. Participants of surveys and qualitative studies were older persons, rural people, practitioners, public health professionals, or community dwellers.

Regarding study setting, most studies were conducted in tertiary health care (university, hospital, specialized centre) (n = 22),^{17–19,22,25,26,28,30,32,33,35–40,42,43,45–48} followed by the community (n = 9)^{20,21,23,24,29,31,34,41,44} and public primary health care (n = 1).²⁷ The original clinical studies, surveys, and qualitative studies were conducted in 23 countries located in five continents (Africa, Americas, Asia, Europe, and Oceania): Brazil, Cameroon, China, Croatia, Czech Republic, Ethiopia, India, Iran, Iraq, Israel,

Italy, Japan, Malaysia, New Zealand, Saudi Arabia, Senegal, South Korea, Spain, Taiwan, Thailand, Turkey, and United States.^{17–48}

Regarding phytotherapy concept, 14 studies followed traditional knowledge^{20–24,27,29,31,34,36,38,39,41,44} and 17 had a clinical pharmacology approach.^{17–19,25,26,28,30,32,33,35,37,40,42,43,45,46,48} One systematic review included both concepts.⁴⁷

Results of individual sources of evidence

[Table 2](#) summarizes the main results on the review questions (see [Supplementary Table S3](#) for detailed results. [Table S4](#) shows the funding sources of the included papers). Twenty-one studies assessed QoL,^{17–19,22,23,25,26,28,30,32,33,35–40,42,46–48} seven reported healthcare access issues,^{24,27,29,31,34,41,45} and 11 cited costs.^{20,21,24,27,29,34,36,37,41,44,45} The clinical trials (n = 15)^{17–19,22,25,26,28,30,32,33,35,37,40,46,48} and observational clinical studies (n = 2)^{38,39} investigated specific posology to treat or prevent a given oral health condition and assessed efficacy, safety, and QoL. Treatment period ranged from 6 days to 6 months.^{17–48} Most studies reported no significant adverse reactions with herbal medicines, except for gastric upset and nausea (n = 2).^{35,40}

Herbal medicines comprised mouthwashes in aqueous vehicle, topical pastes, oil mouth rinses, and medications for ingestion. The mostly used single plants were *Aloe vera*, *Myrtus communis*, *Althaea radix*, *Chamaemelum nobile*, *Plantago major*, *Plantago ovate*, Wu Mei (*Fructus mume*), San Qi (*Radix Notoginseng*), and Tian Hua Fen (*Radix Trichosanthis*). Traditional Chinese, Persian, Ayurveda, and Japanese Kampo (Hangeshashinto) medicines often used herbal formula with medicinal plants, which were prepared by professionals or acquired as commercial products. Surveys (n = 8),^{20,21,23,27,29,31,43,44} narrative reviews (n = 2),^{34,45} systematic reviews (n = 2)^{42,47} also reported the use of single medicinal plants *in natura*, extracts, herbal formula, and commercial products.

Synthesis of results

Phytotherapy has been used for oral health problems in adult populations worldwide, following modern clinical pharmacology and traditional knowledge concepts. Herbal medicines were used as preparations of single medicinal plants, herbal formula with combination of plants, and commercial products, with a variety of extracts and posology.

In clinical studies,^{17–19,22,25,26,28,30,32,33,35,37–40,46,48} the most frequent treatment was herbal mouthwashes to prevent or treat oral mucosa conditions and symptoms, such as oncotherapy-induced mucositis, aphthous stomatitis, burning mouth syndrome, and xerostomia. Efficacy of herbal medicine was often better than placebo, control or no treatment, with no significant adverse reaction.^{18,19,2,25,26,28,30,32,33,35,36,38–40,42,46,48} Surveys,^{20,21,23,27,29,31,43,44} qualitative studies,^{24,36,41} and reviews^{34,45} disclosed a broad use of medicinal plants, mostly traditional folk herbal medicines for several ailments, including toothache, gingivitis, halitosis, oral lesions, and pain, sometimes with local healers' intervention. Traditional Chinese, Japanese Kampo, Indian Ayurveda, and Persian

Table 1 Summary of the general characteristics of the included studies (n = 32).

Reference	Study design	Participants/sample	Study setting	Country	Phytotherapy concept
Su et al. (2004) ¹⁷	RCT	58 patients with head-and-neck carcinoma and radiotherapy	University, hospital	United States	CP
Babae et al. (2010) ¹⁸	RCT	45 patients with recurrent aphthous stomatitis	University, dental school	Iran	CP
Salazar-Sánchez et al. (2010) ¹⁹	RCT	64 patients with symptomatic oral lichen planus	University, dental school	Spain	CP
Agbor & Azodo (2011) ²⁰	SV	283 customers and traders in village markets	Community	Cameroon	TK
Sumngern et al. (2011) ²¹	SV	419 participants, 60 years or older, from urban, suburban, and rural areas	Community	Thailand	TK
Wu et al. (2011) ²²	RCT	68 Sjogren's syndrome patients and 30 healthy patients	University, hospital	China	TK
Brar et al. (2012) ²³	SV	85 practitioners of ayurveda	Community	United States	TK
Diouf et al. (2013) ²⁴	QS	50 persons from a rural area	Community	Senegal	TK
Pawar et al. (2013) ²⁵	RCT	30 head-and-neck cancer patients with chemo/radiotherapy-induced oral mucositis	Hospital	India	CP
López-Jornet et al. (2013) ²⁶	RCT	75 patients with burning mouth syndrome	University, dental school	Spain	CP
Fontenele et al. (2013) ²⁷	SV	68 health professionals and 8 managers	Primary health care	Brazil	TK
de Rossi et al. (2014) ²⁸	RCT	60 patients with xerostomia, including Sjögren syndrome	University, dental school	United States	CP
Gari et al. (2015) ²⁹	SV	282 individuals from the community; mostly urban	Community	Ethiopia	TK
Skrinjar et al. (2015) ³⁰	RCT	60 patients with hyposalivation	University, dental school	Croatia	CP
Inoue & Umezaki (2016) ³¹	SV	76 individuals, 50 years or older, from a rural village	Community	Japan	TK
Valenzuela et al. (2016) ³²	RCT	62 patients with idiopathic burning mouth syndrome	University, dental school	Spain	CP
Catunda et al. (2016) ³³	RCT	14 women with temporomandibular joint arthralgia and osteoarthritis	University, dental school	Brazil	CP
Naseem et al. (2017) ³⁴	NR	Articles on oil pulling (ayurveda)	Community	—	TK
Heydarirad et al. (2017) ³⁵	RCT	60 head-and-neck cancer patients with xerostomia	University, hospital	Iran	CP
Jiang et al. (2018) ³⁶	QQ	20 head-and-neck patients with radiotherapy	University, hospital	China	TK
Cabrera-Jaime et al. (2018) ³⁷	RCT	50 patients with chemotherapy-induced oral mucositis	Oncology centres	Spain	CP
Ben-Arye et al. (2018) ³⁸	OCS	34 patients with chemotherapy-induced taste disorder	Oncology service	Israel	TK
Lim et al. (2019) ³⁹	OCS	42 head-and-neck cancer patients with radiotherapy	National cancer institute	Malaysia	TK
Hasheminasab et al. (2020) ⁴⁰	RCT	28 patients with chemotherapy-induced oral mucositis	Oncology centres	Iran	CP
Guo et al. (2020) ⁴¹	QS	14 participants from three cities in New Zealand	Community	New Zealand	TK

Author(s) (Year) ⁴²	Study Design	Study Population	Intervention	Setting	Country
Eubank et al. (2021) ⁴²	SR	24 articles of clinical trials on oncotherapy-induced oral mucositis		Research/care facility	Iran, Italy, Brazil, USA, India, China, Turkey, New Zealand, Taiwan, Iraq, Spain
Chagas et al. (2021) ⁴³	SV	66 orofacial pain patients		University, dental school	Brazil
Ismail et al. (2021) ⁴⁴	SV	421 participants		Community	Saudi Arabia
Safarzadeh et al. (2022) ⁴⁵	NR	32 papers: 16 clinical trials, 5 systematic reviews, 11 other types		University, research/care facility	—
Yuce et al. (2022) ⁴⁶	CCT	94 head-and-neck cancer patients with radiotherapy		University, radiation oncology department	Turkey
Zhou et al. (2023) ⁴⁷	SR	59,289 participants from 564 clinical studies on Chinese herbal medicine		University, research/care facility	China, India, Iran, Saudi Arabia, South Korea, Thailand
Chytlova et al. (2023) ⁴⁸	RCT	30 patients with extraction of a lower third molar		University, hospital	Czech Republic

Abbreviations: RCT, randomized clinical trial; SV, cross-sectional survey; QS, qualitative study; NR, narrative review; OCS, observational clinical study; SR, systematic review; CCT, controlled clinical trial; CP, clinical pharmacology; TK, traditional knowledge.

medicines were the most reported local knowledge systems.

QoL was objectively measured in intervention and observational clinical studies. QoL had heterogeneous results on improvement of oral conditions with phytotherapy in comparison with control treatment or placebo. Eleven studies^{18,19,22,25,33,35,36,38–40,46} found that QoL improved with herbal medicine, and five studies^{26,28,30,32,47} found no difference in QoL compared with placebo. Several validated instruments were used: the Oral Health Impact Profile (OHIP-14, OHIP-49, and a modified OHIP version), the European Organization for Research and Treatment of Cancer QoL Questionnaire (EORTC QLQ-C30), the EORTC Head and Neck Cancer QoL Module (QLQ-HN35), the Head and Neck Cancer-Specific QoL Questionnaire, the Short Form-36 Health Survey (SF-36), and the Edmonton symptom assessment scale (ESAS). Some studies used customized questionnaires. Surveys and qualitative studies reported QoL in popular terms used by participants.

No specific study on healthcare access or costs was found, and reports were mainly discussed in surveys, qualitative studies, and reviews. Participants' responses often favoured traditional herbal medicine in comparison with 'western', 'modern' or synthetic medicines. Most participants reported that traditional folk herbal medicine was the preferred, first-line or only available option for oral health care. In one qualitative study an elderly patient mentioned that traditional Chinese herbal medicine was too expensive.³⁶ A clinical trial discussed that the herbal solution was less advantageous than the control solution, which was inexpensive and had no need for professional preparation.³⁷

Discussion

This scoping review sought to describe the use of medicinal plants and herbal medicines by adults, and their behavioural outcomes reflected how people see its benefits and limitations. Clinical efficacy and safety, patient-centred outcomes, sociocultural and economic evaluation are necessary to assess health interventions for effective translation into practice and policy.^{1,2} Our findings showed that phytotherapy has been used for oral health across the world, following traditional knowledge or clinical pharmacology concepts. Overall, patients, professionals, and community dwellers had a positive opinion on phytotherapy regarding clinical effect, QoL, access, and costs, within the study boundaries.

Most herbal medicines in the included studies were used topically, usually mouthwashes to rinse and spit, although some were swallowed. This can explain the reporting of few adverse reactions and good adherence to treatment. Mouthwashes were mainly prepared with one plant extract, but composition and posology varied largely. Conversely, several traditional Chinese and Japanese medicines also were ingested and prepared as herbal formula to balance the whole body and energy besides the oral problem.

In clinical studies, herbal mouthwashes were tested for a specific condition, such as mucositis or burning mouth syndrome. These are non-infectious and chronic oral problems that affect QoL and well-being. Laboratory and preclinical research has shown promising effects of herbal

Table 2 Summary of the main results on the specific review questions from the included studies (n = 32).

Reference	Clinical outcomes	Behavioural and QoL outcomes	Healthcare access	Costs
Su et al. (2004) ¹⁷	Oral aloe vera solution did not improve tolerance to radiotherapy or decrease OM and soreness (placebo: no treatment). No report of adverse effects.	<i>Aloe vera</i> did not improve QoL: overall health, soreness, and effect on daily activity: brushing teeth, swallowing, and eating.	Access to tertiary care setting	Not mentioned
Babae et al. (2010) ¹⁸	Oral paste with 5 % myrtle reduced ulcer size, pain severity, erythema, and exudation in recurrent aphthous stomatitis (placebo: no treatment). No report of side effects.	Myrtle paste improved QoL and patient overall assessment of treatment.	Access to tertiary care setting	Not mentioned
Salazar-Sánchez et al. (2010) ¹⁹	Mouthwash of 70 % aloe vera improved pain and lesions of oral lichen planus in 81 % of the patients, with complete remission in 7 %; 4 % improved with placebo (no treatment), no full remission. No report of adverse effects.	<i>Aloe vera</i> improved the psychological disability domain and QoL.	Access to tertiary care setting	Not mentioned
Agbor & Azodo (2011) ²⁰	The prevalence of self-medication for several oral health problems was 67.8 %, mainly for toothache (54.7 %); 27.8 % used native herbs.	Duration at experiencing symptom alleviation was reported.	Not mentioned	46.5 % reported lack of money
Sumngern et al. (2011) ²¹	97.4 % of the Thai elderly used herbal medicines as traditional medicines, supplements, and food flavourings.	Herbal medicine was associated with happiness. Beliefs: herbals reduce/cure diseases (41.9 %), relieve symptoms (35.4 %), and provide good health (33.6 %).	Not mentioned	51 % reported that herbals reduce expenses
Wu et al. (2011) ²²	Chinese herbal medicine for strengthening qi, nourishing yin, and removing stasis alleviated primary Sjogren's syndrome symptoms.	Chinese herbal medicine improved QoL overall score.	Access to tertiary care setting	Not mentioned
Brar et al. (2012) ²³	74 % used ayurvedic herbals for treatment (of oral malodour, gingival or periodontal disease and toothache), mostly for preventive traditional care and oral hygiene.	Some individuals believed ayurveda can be used as an adjunct to conventional therapy to improve QoL.	Not mentioned	Not mentioned
Diouf et al. (2013) ²⁴	Participants used plants (inhalation, mouthwashes or with chewing stick rubs) for oral diseases and pain: toothache, gingivitis, mouth ulcers, thrush, periodontal disease, caries, and stomatitis.	The use of medicinal plants was often accompanied by litanies, incantations, and mystical words by healers.	Limited access to oral health services	Dentists cost twice as much as traditional healers
Pawar et al. (2013) ²⁵	SAMITAL® (<i>Vaccinium myrtillus</i> , <i>Macleaya cordata</i> and <i>Echinacea angustifolia</i>) decreased the pain and severity of OM induced by chemo or radiotherapy for head-and-neck cancer (placebo: no treatment). No report of adverse events.	SAMITAL® improved QoL on swallowing, drinking, eating, speaking, and sleeping, in comparison with placebo.	Access to tertiary care setting	Not mentioned
López-Jornet et al. (2013) ²⁶	Combined use of tongue protector and aloe vera was effective for burning mouth syndrome. Group I used the protector; group II, the protector and aloe vera; and group III, the protector and placebo. No report of	QoL improved but did not differ among groups, except for the handicap domain.	Access to tertiary care setting	Not mentioned

Fontenele et al. (2013) ²⁷	adverse effects. 79.4 % of health professionals reported personal use of herbal medicine and benefits for less side effects.	95.6 % accept phytotherapy in the public health system to meet public needs and popular use.	Benefits for improving access to primary care	Benefits for reducing costs
de Rossi et al. (2014) ²⁸	MighTeaFlow formula (2 plant extracts including green tea) increased saliva output vs. placebo (500 mg xylitol) in patients with xerostomia, including Sjögren syndrome. No report of adverse effects.	QoL improved over time, with no difference between treatment and placebo groups.	Access to tertiary care setting	Not mentioned
Gari et al. (2015) ²⁹	70.57 % of people used medicinal herbs as traditional medicine rather than modern medicine; 40.79 % were aware of side effects.	6.8 % believed that traditional medicine could cure toothache better than modern medicine.	24.07 % preferred traditional medicine: accessible	31.85 % preferred traditional medicine: cheap
Skrinjar et al. (2015) ³⁰	All agents reduced hyposalivation symptoms: thermal spring water (Buccotherm®); saliva substitute (Xeros®); marshmallow root (<i>Althaeae radix</i> , galenic remedy).	Thermal spring water had the largest effect on QoL when compared with saliva substitute and marshmallow root.	Access to tertiary care setting	Not mentioned
Inoue & Umezaki (2016) ³¹	All respondents used at least two types of treatment among formal clinical care, OTC-drug, Kampo, or personal hygiene practices. Toothache was primarily treated in the clinical setting, with few users of Kampo and indigenous medicine.	Older participants were more likely to use Kampo indigenous herbal/animal medicine.	Access to all healthcare options	Not mentioned
Valenzuela et al. (2016) ³²	For burning mouth syndrome, pain and xerostomia improved at 15 and 30 days in both 2 % chamomile gel and placebo (no treatment) groups. No adverse effect reported.	QoL improved at 15 and 30 days in both treatment and placebo groups.	Access to tertiary care setting	Not mentioned
Catunda et al. (2016) ³³	Avocado-soybean unsaponifiable oil (Flexi-Smart 300 mg) decreased pain and medication use compared to placebo for arthralgia and osteoarthritis of temporomandibular joint. No report of side effects.	Test group had improved QoL.	Access to tertiary care setting	Not mentioned
Naseem et al. (2017) ³⁴	Oil pulling therapy (sunflower, sesame, coconut oil) decreased dental caries, reduced plaque and gingivitis, improved halitosis and oral thrush. Most oils have no side effects.	Oil pulling therapy is simple, ease, and cost-effective to improve and maintain good oral health and general health at home.	Useful for people with limited access to oral health care	The cost per oil pulling rinse is less than mouth rinses
Heydarirad et al. (2017) ³⁵	Traditional Persian medicine (<i>A. digitata</i> and <i>M. Sylvestris</i>) was effective for patients with head-and-neck cancer and xerostomia. Some adverse events, such as gastric upset and nausea.	Improvement in QoL domains of swallowing, speech, and eating for both groups of TPM preparation and artificial saliva spray. Only TPM improved pain.	Access to tertiary care setting	Not mentioned
Jiang et al. (2018) ³⁶	Head-and-neck cancer patients with xerostomia after radiotherapy reported symptom relief with traditional Chinese treatments, such as qigong, gua sha, and traditional Chinese herbal medicine.	TCHM relieved xerostomia and symptoms affecting QoL: discomfort to eat and speak, pain and irritation, avoid socializing.	Access to tertiary care setting	TCHM is too expensive (one patient report)
Cabrera-Jaime et al. (2018) ³⁷	Healing time or pain of chemotherapy-induced OM did not differ among group 1 - double dose of sodium	Before and after treatment, patients reported a low to medium QoL, with	Access to tertiary care setting	Herbal solution would be less cost-

(continued on next page)

Table 2 (continued)

Reference	Clinical outcomes	Behavioural and QoL outcomes	Healthcare access	Costs
Ben-Arye et al. (2018) ³⁸	bicarbonate 5 % aqueous solution; group 2 - plus <i>Plantago major</i> extract; and group 3 - plus chlorhexidine 0.12 %. No report of adverse effects. Most patients reported a reduction in chemotherapy-induced taste disorder. Acupuncture and herbal medicine (sage, carob, and wheat grass juice, as mouthwash or topical paste) were mostly used. No adverse effects.	no difference among groups. Assessment was optimal for 18/29 patients, who reported QoL improvement in fatigue, drowsiness, and depression.	Access to tertiary care setting	effective than sodium bicarbonate Not mentioned
Lim et al. (2019) ³⁹	Chinese herbal treatment (prescription, formula, single herb) improved xerostomia and salivary flow rate in relation to control group, in head-and-neck cancer with radiotherapy.	Herbal treatment improved QoL: speech, eating, and pain at the 6th month.	Access to tertiary care setting	Not mentioned
Hasheminasab et al. (2020) ⁴⁰	<i>Plantago ovate</i> mouthwash reduced the breast cancer chemotherapy-related OM, the severity of pain and xerostomia, in comparison with placebo (only oral care). Two patients reported nausea.	The herbal mouthwash improved the patients' QoL, in comparison with placebo.	Access to tertiary care setting	Not mentioned
Guo et al. (2020) ⁴¹	Traditional medicine, including plants, was used by different ethnic groups for dental/non-dental pathologies in the orofacial region. Report of less side effects.	Choice reasons included family tradition, access to traditional medicine, and finding a competent traditional healer.	For most people, traditional medicine is the first-line option	Barrier: costs
Eubank et al. (2021) ⁴²	<i>M. chamomilla</i> decreased oncotherapy-induced OM and improved pain. <i>Isatis indigótica</i> , <i>Olea europaea</i> , <i>Calendula officinalis</i> , <i>A. digitatae</i> , and <i>M. sylvestris</i> improved OM. Mucotrol™ improved the lesion severity. SAMITAL®, MUCOSYTE and CHIN promoted good pain control. Few side effects.	2/24 articles investigated QoL outcomes.	Access to tertiary care setting	Not mentioned
Chagas et al. (2021) ⁴³	59 % of patients used integrative and complementary practices for orofacial pain, mainly phytotherapy (28.8 %).	97 % had previous knowledge; most believed that they have benefits for health.	Access to tertiary care setting	Not mentioned
Ismail et al. (2021) ⁴⁴	50.5 % of participants used herbs as an alternative medicine for several oral health problems: swelling, tooth cavities, oral lesions, gum problems. 63 % believed it is safe.	Not mentioned	Not mentioned	18.4 % reported the low cost to use alternative medicine
Safarzadeh et al. (2022) ⁴⁵	Curcumin, <i>Aloe vera</i> , and propolis showed favourable effects on OM. Calendula, silymarin, ginseng, green tea, and Kampo improved OM. No significant side effects.	Reports that herbal medicine and medicinal plants are natural, inexpensive, available, and accessible.	Report: 'Herbal medicines are accessible'	Report: 'Herbal medicines are not expensive'
Yuce et al. (2022) ⁴⁶	Both grape and black mulberry molasses improved pain in comparison with no treatment for head-and-neck cancer treated with radiotherapy.	Improved QoL: swallowing, opening mouth, weight loss, role functioning, emotional and social functioning, fatigue, appetite, pain.	Access to tertiary care setting	Not mentioned

<p>Zhou et al. (2023)⁴⁷</p> <p>Chinese herbal medicine mouthwashes were used for several conditions, mainly recurrent aphthous ulcer, gingivitis, periodontitis, radio- or chemotherapy-induced OM, gastrointestinal disease, and post-operative oral problem.</p>	<p>Reported outcome measures were clinical endpoint (82.80 %), safety (8.87 %), patient satisfaction (6.38 %), QoL (4.96 %), and economic indicators (3.01 %).</p>	<p>Access to tertiary care setting</p>	<p>Not mentioned</p>
<p>Chytlova et al. (2023)⁴⁸</p> <p>The topical herbal paste (<i>Lonicera caerulea</i> and <i>Macleaya cordata</i>) reduced pain and analgesic needs after lower third molar surgery compared with placebo. No adverse effects.</p>	<p>Post-extraction QoL did not improve over time (up to 6 days) for both treatment and placebo groups.</p>	<p>Access to tertiary care setting</p>	<p>Not mentioned</p>

Abbreviations: QoL, quality of life; OM, oral mucositis; OTC, over-the-counter; TPM, traditional Persian medicine; TCHM, traditional Chinese herbal medicine.

extracts and compounds to tackle infectious diseases, such as caries and periodontal problems, but clinical trials are limited.^{6–8} The present review could not include clinical trials on infectious oral diseases because many publications assessed in full-text did not include QoL, access or costs in their results.

Patient-centred outcomes should be routinely evaluated in clinical and epidemiological studies. However, there is a need to standardize oral health concepts and research methods.⁴⁹ Because different QoL instruments were used, direct comparisons for the same oral health condition may not be possible in the included clinical studies. Surveys and qualitative studies highlighted QoL as a reason for using traditional herbal medicine in participants' opinion, as well as issues on healthcare access and costs. Studies showed that limited access and high costs can impair healthcare choice, acceptance, and adherence in underserved populations.

In relation to access and costs, it is important to distinguish clinically prescribed and regulated herbal products from folk medicinal plants and homemade medicines, which are used as self-medication or by community healers. In addition, traditional Chinese, Kampo, Ayurveda, and Persian medicine can be expensive as they are highly structured knowledge systems, whose herbal medicines are also prescribed in tertiary care and purchased in specialized stores, similarly to synthetic drugs.

The main strength of the present scoping review is the comprehensive and systematic search of six major databases and the grey literature. However, the database searches may have not included some local publications from Asia, Africa, and Middle East, where traditional medicine is common. Moreover, many records from the grey literature had incorrect, not retrievable information. We excluded a few studies with no available full-text, even after contacting the corresponding author. Lastly, the risk of bias and quality of studies were not appraised as this is optional in scoping reviews.¹⁶

In summary, the rational use of herbal medicines can prevent and ameliorate oral health problems, supported by clinical studies or traditional knowledge systems. However, few studies have investigated QoL, healthcare access, and costs beyond clinical outcomes, which are complementary aspects for delivering large-scale and efficient health care for all people.

For herbal medicines with positive clinical efficacy and safety, further research should focus on economic evaluation, including 'real-world' cost-effectiveness of phytotherapy to prevent common oral health problems and improve chronic conditions that impact QoL. For practice and policy, special attention should be given to vulnerable people, such as socioeconomic disadvantaged, older or remote populations, with limited access to formal healthcare services.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

This study was funded by the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq), Ministry

of Science, Technology and Innovations, Brazil (Grant CNPq 25/2021 - 101790/2022-8). The funder had no role in any study phase, publication decision or manuscript preparation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jds.2024.01.002>.

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