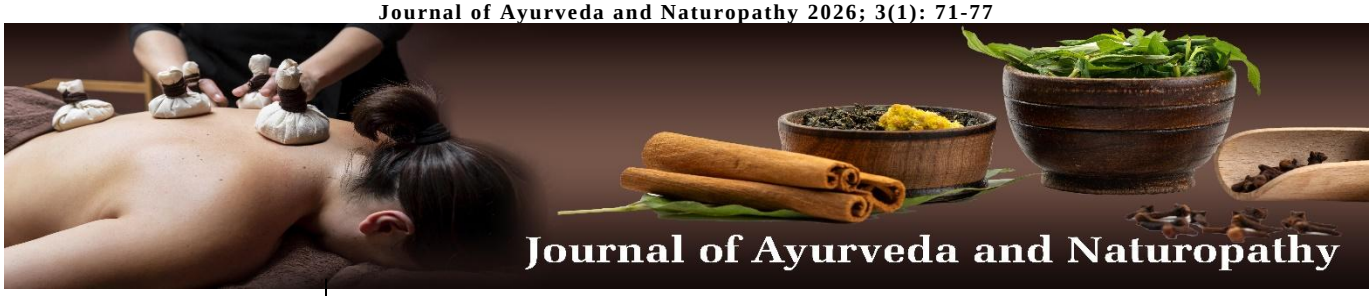

ISSN Print: 3078-6282
ISSN Online: 3078-6290
Impact Factor (RJIF): 5.48
JAN 2026; 3(1): 71-77
https://www.ayurvedjournal.net
Received: 02-11-2025
Accepted: 04-12-2025

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Ethnobotanical knowledge in Ayurveda for treating lifestyle disorders: documentation and scientific validation

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DOI: https://www.doi.org/10.33545/ayurveda.2026.v3.i1.B.47

Abstract
Lifestyle disorders such as type 2 diabetes mellitus, obesity, dyslipidaemia, hypertension, non-alcoholic fatty liver disease (NAFLD) and stress-related disorders are now major public health challenges in India and globally. Ayurveda, grounded in rich ethnobotanical traditions, offers a holistic framework for preventing and managing these conditions through plant-based formulations, diet, daily and seasonal regimens, and Rasayana (rejuvenative) therapies. This review synthesizes ethnobotanical documentation and scientific validation of medicinal plants used in Ayurveda and local health traditions for the management of lifestyle disorders.

Ethnobotanical compilations from India indicate that about 800-1300 plant species have been reported as antidiabetic or cardiometabolic in traditional practice. Frequently cited taxa include *Tinospora cordifolia*, *Momordica charantia*, *Syzygium cumini*, *Trigonella foenum-graecum*, *Azadirachta indica*, *Phyllanthus emblica* and *Gymnema sylvestre*, widely used in both classical Ayurvedic formulations and community remedies. Recent ethnobotanical surveys in India and neighbouring countries continue to document new uses and under-reported species for diabetes and metabolic syndrome.

Pharmacological studies demonstrate hypoglycaemic, hypolipidaemic, antioxidant, anti-inflammatory and adaptogenic properties for many of these plants, particularly *T. cordifolia*, *M. charantia*, *W. somnifera*, *P. emblica* and *C. wightii*. Clinical trials and systematic reviews show that standardized extracts and polyherbal formulations can improve glycaemic control, lipid profiles, anthropometric parameters and stress indices, with generally acceptable short-term safety. However, limitations include small sample sizes, short duration, heterogeneity of preparations, and limited long-term safety and pharmacovigilance data.

This article (i) reviews the ethnobotanical foundations of Ayurvedic management of lifestyle disorders, (ii) summarizes key plant species and their pharmacological evidence, (iii) collates clinical evidence for selected single herbs and polyherbal formulations, and (iv) proposes a framework for integrating ethnobotanical documentation, reverse pharmacology and rigorous clinical trials. Strengthening documentation, community participation, and scientific validation can help transform traditional knowledge into culturally rooted, evidence-based strategies for combating lifestyle disorders.

Keywords: Ayurveda, ethnobotany, lifestyle disorders, type 2 diabetes, metabolic syndrome, medicinal plants, scientific validation

1. Introduction

1.1 Background and Context

Lifestyle disorders driven by physical inactivity, unhealthy diet, psychosocial stress, tobacco and alcohol use now account for the majority of non-communicable disease (NCD) burden worldwide. India has witnessed a rapid rise in cardiometabolic disorders; estimates suggest over 77 million people with diabetes and a high prevalence of obesity and metabolic syndrome, particularly in urban and peri-urban areas (Patil *et al.*, 2011; Modak *et al.*, 2007) [11, 9].

Ayurveda conceptualizes these conditions in terms of derangements of *Agni* (digestive/metabolic fire), accumulation of *Ama* (toxic, incompletely metabolized products) and imbalance of the three *doshas Vata*, *Pitta* and *Kapha*. Classical texts describe conditions approximating obesity (*Sthaulya*), metabolic syndrome and diabetes (*Prameha*, *Madhumeha*), cardiovascular disease (*Hridroga*) and stress-related disorders. Management

integrates *Ahara* (diet), *Vihara* (lifestyle), *Aushadha* (herbal/mineral medicines) and *Samshodhana* (bio-purification) therapies (Modak *et al.*, 2007; Patwardhan, 2024) [9, 22]. Ethnobotanical knowledge embedded in rural and tribal communities overlaps considerably with classical Ayurvedicmateriamedica. Field surveys across different Indian states (Odisha, Maharashtra, Himachal Pradesh, Kerala, Madhya Pradesh, Odisha Sundargarh district, etc.) document numerous plant remedies for "sugar disease," "fat disease," blood pressure and "heart weakness", often prepared as decoctions, powders, juices or food-based formulations (Ghosh *et al.*, 2024; Gupta *et al.*, 2021; Das *et al.*, 2025; Sahu *et al.*, 2023) [5, 14, 15, 16].

1.2 Rationale and Importance

Although modern pharmacotherapy for lifestyle disorders is effective, it is associated with cost, chronic side-effects, and limited acceptability in some populations. Ethnobotanical and Ayurvedic plant-based therapies are perceived as accessible and culturally acceptable alternatives or adjuncts. Reviews indicate that ethnobotanical sources report 800 or more antidiabetic plants globally, with India contributing a major share (Patil *et al.*, 2011; Modak *et al.*, 2007; Nazar *et al.*, 2024) [11, 9, 17].

Scientific validation is crucial for:

- Identifying safe and effective plant-based options for cardiometabolic risk reduction;
- Avoiding toxicity, adulteration and herb-drug interactions;
- Prioritizing conservation and sustainable use of high-demand species;
- Ensuring fair benefit-sharing with knowledge-holding communities.

1.3 Objectives

This review article aims to:

1. Document major Ayurvedic and ethnobotanical plant species used for lifestyle disorders, with emphasis on diabetes, obesity, dyslipidaemia, hypertension, NAFLD and stress-related disorders.
2. Summarize pharmacological evidence supporting key ethnobotanical claims.
3. Present clinical evidence (where available) for selected single herbs and polyherbal formulations.
4. Propose a framework for systematic documentation and scientific validation grounded in Ayurveda and ethnobotany.

1.4 Scope and Limitations

The focus is on plant-based Ayurvedic and local health-tradition interventions. Yoga, purely dietary and mineral-only therapies are mentioned only where they intersect with herbal approaches. The review is narrative but informed by recent systematic reviews and clinical trials up to early 2025 (Palla *et al.*, 2021; Arumugam *et al.*, 2024; Giri *et al.*, 2025; Khan *et al.*, 2023) [10, 2, 18, 19]. Because of database and access constraints, the article does not claim exhaustive coverage of all relevant trials or ethnobotanical reports, and long-term safety data remain limited.

2. Literature Review

2.1 Historical foundations of Ayurvedic and ethnobotanical knowledge

Classical Ayurvedic treatises such as *Charaka Samhita* and *Sushruta Samhita* describe numerous *dravyas* (substances) for *Prameha*, *Sthaulya* and related conditions, including *Neem* (*Azadirachta indica*), *Guduchi* (*Tinospora cordifolia*), *Jambu* (*Syzygium cumini*), *Karavellaka* (*Momordica charantia*), *Methika* (*Trigonellafoenum-graecum*), *Haritaki* (*Terminalia chebula*), *Amalaki* (*Phyllanthus emblica*), *Guggulu* (*Commiphora wightii*), *Arjuna* (*Terminalia arjuna*) and *Ashwagandha* (*Withania somnifera*) (Modak *et al.*, 2007; Singh *et al.*, 2003) [9, 21].

Many of these plants function as *Rasayana* drugs, aimed at enhancing tissue resilience, delaying ageing and correcting metabolic imbalance. Their use through centuries in both classical and folk settings provides a large "pre-clinical" human database, which modern reverse pharmacology seeks to formalize and validate (Patwardhan, 2024; Panchabhai *et al.*, 2008) [22, 23].

2.2 Ethnobotanical documentation of lifestyle-related uses

Systematic ethnobotanical surveys in India and South Asia have catalogued extensive use of plants for diabetes and metabolic complaints. For example, Patil *et al.* (2011) [11] reviewed 33 Indian medicinal plants with documented antidiabetic activity, emphasizing *Aegle marmelos*, *M. charantia*, *G. sylvestre*, *Pterocarpus marsupium*, *S. cumini*, *T. cordifolia* and *T. foenum-graecum*.

A national-scale database compiled by Ghosh *et al.* (2024) [5] lists 1305 plant species reported as antidiabetic in Indian ethnobotanical literature, with state-wise distributions and references, highlighting regions like Kerala, Odisha, Maharashtra and Himachal Pradesh as hotspots of ethnomedicinal use. State- and community-level surveys, such as those among the Bhuyan tribe of Sundargarh (Sahu *et al.*, 2023) [16], tribal communities of Mandla district, Madhya Pradesh, and several biosphere reserves, further detail local names, parts used and modes of preparation (Sahu *et al.*, 2023; Das *et al.*, 2025) [15, 16].

Outside India, ethnobotanical surveys in Bangladesh, Pakistan and Sri Lanka report overlapping plant repertoires, with *M. charantia*, *G. sylvestre*, *Moringa oleifera* and *Coccinia indica* frequently cited Nazar *et al.*, 2024; Niluka *et al.*, 2024) [17, 20]. These convergences support the robustness of ethnomedicinal claims.

2.3 Theoretical framework: Ayurveda and lifestyle disorders

In Ayurvedic nosology, *Prameha* and *Madhumeha* (diabetes-like conditions) arise from *Kapha*- and *Medo-dusti* (derangement of phlegm and adipose tissue), reduced *Agni*, sedentary lifestyle, excessive intake of *guru* (heavy), *snigdha* (unctuous) and *madhura* (sweet) foods, and psychological factors such as stress and grief (Modak *et al.*, 2007) [9]. Obesity (*Sthaulya*) is seen as excess *Medas* (fat) and *Kapha*, often a precursor to *Prameha*.

Ayurvedic management employs:

- Deepana-Pachana herbs (digestive and carminative) such as *Zingiber officinale*, *Piper longum* and *Piper nigrum* (Trikatu) to kindle *Agni*;
- Lekhana (scraping) and *Medohara* (lipid-reducing) drugs like *Guggulu*, *Mustaka* (*Cyperus rotundus*), *Triphalā* and *Vidanga*;
- Tikta-Kashaya Rasa (bitter-astringent) drugs such as *Neem*, *Guduchi*, *M. charantia* and *G. sylvestre* for glycaemic and lipid control (Yenepoya Ayurveda Metabolic Disorders Guideline, 2024; Jaims Metabolic Syndrome Review, 2025).

Table 1 summarizes the conceptual mapping between major lifestyle disorders and Ayurvedic constructs.

Table 1: Lifestyle disorders and corresponding Ayurvedic constructs

Lifestyle disorder	Ayurvedic construct(s)	Key pathological concepts
Type 2 diabetes, metabolic syndrome	*Prameha*, *Madhumeha*	*Kapha-Medodusti*, *Agni-mandya*, *Ama*
Obesity	*Sthaulya*	Excess *Medas*, *Kapha* predominance
Dyslipidaemia, atherosclerosis	*Medoroga*, *Hridroga*	*Medovriddhi*, *Srotorodha* (channel obstruction)
NAFLD	*Yakritvikara*, *Pittaja*/*Kapha* disorders	Fatty infiltration, *Ama* accumulation
Hypertension	*RaktagataVata*, *UchchaRaktachaapa* (in modern texts)	*Vata* vitiation, *Rakta* involvement
Stress, anxiety, insomnia	*Manasika vyadhi*, *Anidra*, *Chittodvega*	*Rajas-Tamas* imbalance, *Vata* aggravation

(Sources: Modak *et al*., 2007; Patwardhan, 2024; Jaims Metabolic Syndrome Review, 2025) [9, 22].

2.4 Research gaps identified in the literature

Despite an impressive ethnobotanical and textual base, several gaps remain:

- Under-documentation of many local uses, particularly in rapidly urbanizing regions.
- Limited pharmacological evaluation of numerous plants highlighted by recent surveys (Niluka *et al.*, 2024; Das *et al.*, 2025) [15, 20].
- Fragmented clinical evidence with small trials, varied formulations and inconsistent endpoints (Palla *et al.*, 2021; Arumugam *et al.*, 2024) [10, 2].
- Inadequate standardization, quality control and pharmacovigilance in many marketed products (Gupta *et al.*, 2024) [14].

These gaps motivate the present synthesis and the framework proposed later.

3. Materials and Methods

3.1 Study design

This is a narrative review integrating:

- classical Ayurvedic literature (via secondary scholarly sources);
- ethnobotanical surveys and databases pertaining to Indian plants used for diabetes and related disorders;
- pharmacological studies on mechanisms relevant to lifestyle disorders;
- Clinical studies (RCTs, observational trials and systematic reviews) up to early 2025.

3.2 Data sources and search strategy

Scientific literature was searched in PubMed, ScienceDirect, Google Scholar and selected journals using terms such as "Ayurveda lifestyle disorders", "ethnobotanical antidiabetic plants India", "*Tinospora cordifolia* clinical trial diabetes", "Ashwagandha stress meta-analysis", "Ayurvedicpolyherbal obesity" and "Ayurveda metabolic syndrome." Representative sources include Patil *et al.* (2011) [11], Ghosh *et al.* (2024) [5], Modak *et al.* (2007) [9], Arumugam *et al.* (2024) [2], Palla *et al.* (2021) [10] and Giri *et al.* (2025) [18]. Ethnobotanical data were drawn from surveys in Indian states and from cross-country reports in South Asia (Ghosh *et al.*, 2024; Nazar *et al.*, 2024; Niluka *et al.*, 2024; Das *et al.*, 2025) [5, 15, 20, 17].

3.3 Inclusion and exclusion criteria

Included

- Studies on medicinal plants used in Ayurvedic or Indian ethnomedicinal contexts for lifestyle disorders.
- Pharmacological studies on antidiabetic, hypolipidaemic, antihypertensive, hepatoprotective or adaptogenic effects relevant to lifestyle disorders.
- Human clinical trials and systematic reviews involving single herbs or polyherbal formulations.

Excluded

- Studies solely on non-plant interventions (purely yoga, diet or minerals) unless part of combined Ayurvedic protocols.
- Articles lacking sufficient methodological detail or without identifiable plant species.

3.4 Data analysis

Given heterogeneity, no formal meta-analysis was attempted. Data were qualitatively synthesized, focusing on consistency between ethnobotanical usage, pharmacological mechanisms and clinical outcomes.

4. Results

4.1 Key Ayurvedic-ethnobotanical plants for lifestyle disorders

Table 2 summarises selected high-priority plants with strong ethnobotanical usage and pharmacological/clinical evidence.

Table 2: Major Ayurvedic and ethnobotanical plants used in lifestyle disorders

Plant (Ayurvedic/Latin)	Major traditional indications	Key mechanisms / experimental findings
Guduchi - Tinospora cordifolia	Diabetes, obesity, dyslipidaemia, liver disorders, immunity	Hypoglycaemic, antioxidant, immunomodulatory, hepatoprotective (Prince *et al.*, 2004; Singh *et al.*, 2003; Gupta *et al.*, 2024) [14, 21, 24]
Karavellaka - Momordica charantia	Diabetes, dyslipidaemia	Insulin-mimetic peptides, improved glucose utilisation, lipid-lowering (Patil *et al.*, 2011; Modak *et al.*, 2007) [11, 9]
Jambu - Syzygium cumini	Diabetes, diarrhoea	Seed polyphenols reduce hyperglycaemia and oxidative stress (Patil *et al.*, 2011) [11]
Methika - Trigonella foenum-graecum	Diabetes, dyslipidaemia	Fiber-rich, delayed carbohydrate absorption, improved insulin sensitivity (Modak *et al.*, 2007) [9]
Neem - Azadirachta indica	Diabetes, skin, infections	Bitter principles, improved glycaemic control, antioxidant (Patil *et al.*, 2011) [11]
Amalaki - Phyllanthus emblica	Rasayana, dyslipidaemia, NAFLD	Potent antioxidant, hepatoprotective, lipid-lowering (Panchabhai *et al.*, 2008) [23]
Guggulu - Commiphora wightii	Obesity, dyslipidaemia, atherosclerosis	Hypolipidaemic, “scraping” action, anti-inflammatory (Yenepoya Guideline, 2024)
Ashwagandha - Withania somnifera	Stress, anxiety, insomnia, metabolic stress	Adaptogenic, cortisol-lowering, improved stress markers (Arumugam *et al.*, 2024; Mikulska *et al.*, 2023) [2, 25]
Arjuna - Terminalia arjuna	Cardiac disorders, hypertension	Cardioprotective, antioxidant, improved ejection fraction in some trials (Modak *et al.*, 2007) [9]

(Sources: Patil et al., 2011; Modak et al., 2007; Prince et al., 2004; Panchabhai et al., 2008;Arumugam et al., 2024; Mikulska et al., 2023; Gupta et al., 2024; Yenepoya Guideline, 2024) [11, 9, 2, 23, 14, 24, 25].

4.2 Pharmacological validation

- ***Tinospora cordifolia*:** Multiple experimental studies show that *T. cordifolia* reduces fasting blood glucose, restores antioxidant status and protects organs in diabetic animal models (Prince *et al.*, 2004; Prince *et al.*, 2001) [24]. Review work correlates traditional *Rasayana* claims with immunomodulatory and antidiabetic actions (Panchabhai *et al.*, 2008; Gupta *et al.*, 2024) [23, 14].
- ***Momordica charantia*:** Experimental studies demonstrate insulin-mimetic peptides, enhanced glucose uptake and improved lipid profiles, supporting its widespread ethnobotanical use (Patil *et al.*, 2011; Modak *et al.*, 2007) [11, 9].
- ***Withania somnifera*:** Modern work confirms adaptogenic properties, with mechanisms including modulation of HPA axis, GABA-ergic signalling and antioxidant effects (Mikulska *et al.*, 2023; Arumugam *et al.*, 2024) [25, 2]. These mechanisms indirectly impact metabolic risk by reducing chronic stress, a recognized driver of lifestyle disorders.

4.3 Clinical validation

Key examples of clinical evidence include:

- ***T. cordifolia* in type 2 diabetes:** In a randomized trial (n=40), *T. cordifolia* capsules 500 mg three times daily as add-on therapy for type 2 diabetes significantly reduced fasting and post-prandial blood glucose without adverse renal or hepatic effects (Mishra *et al.*, 2015) [7].
- **Ayurvedicpolyherbals in metabolic syndrome and NAFLD:** A systematic review of Ayurvedic interventions for metabolic syndrome and NAFLD found that several formulations containing *Triphala*, *Trikatu*, *Guggulu* and *Guduchi* improved biochemical parameters, though sample sizes were small and methodological quality moderate (Palla *et al.*, 2021; Anonymous, 2023; Jaims Metabolic Syndrome Review, 2025) [10, 26].
- **Ashwagandha for stress and related metabolic risk:** A meta-analysis of nine randomized controlled trials (n=558) showed that *W. somnifera* significantly reduced perceived stress, anxiety and serum cortisol compared to placebo (Arumugam *et al.*, 2024) [2]. Additional RCTs and reviews confirm improvements in sleep quality and well-being (Cheah *et al.*, 2021; Mikulska *et al.*, 2023) [3, 25].
- **Obesity and dyslipidaemia:** A 2025 clinical study reported that multi-herbal formulations Vyoshadi Guggulu and Vidanga Churna reduced body weight, BMI and waist circumference in obese adults, aligning with Ayurvedic concepts of *Lekhana* and *Medohara* (Giri *et al.*, 2025) [18].

Table 3 provides an overview of selected clinical studies.

Table 3: Selected clinical trials of Ayurvedic plants/formulations in lifestyle disorders

Plant / formulation	Study design & sample	Indication	Main outcome
T. cordifolia capsules	RCT, n=40, 6 months (Mishra *et al.*, 2015) [7]	Type 2 diabetes (add-on)	↓ Fasting & PP glucose; no renal/hepatic toxicity
Ashwagandha extract	Meta-analysis of 9 RCTs, n=558 (Arumugam *et al.*, 2024) [2]	Stress/anxiety (risk factor)	↓ PSS, HAS scores; ↓ cortisol
Multi-herbal NAFLD formulations	Multiple small RCTs (Palla *et al.*, 2021; Anonymous, 2023) [10, 26]	NAFLD, metabolic syndrome	Improved liver enzymes, lipids, ultrasound scores
VyoshadiGuggulu + VidangaChurna	Clinical study, obese adults (Giri *et al.*, 2025) [18]	Obesity	↓ Weight, BMI, WC, improved lipids

4.4 Graphical and photographic representations

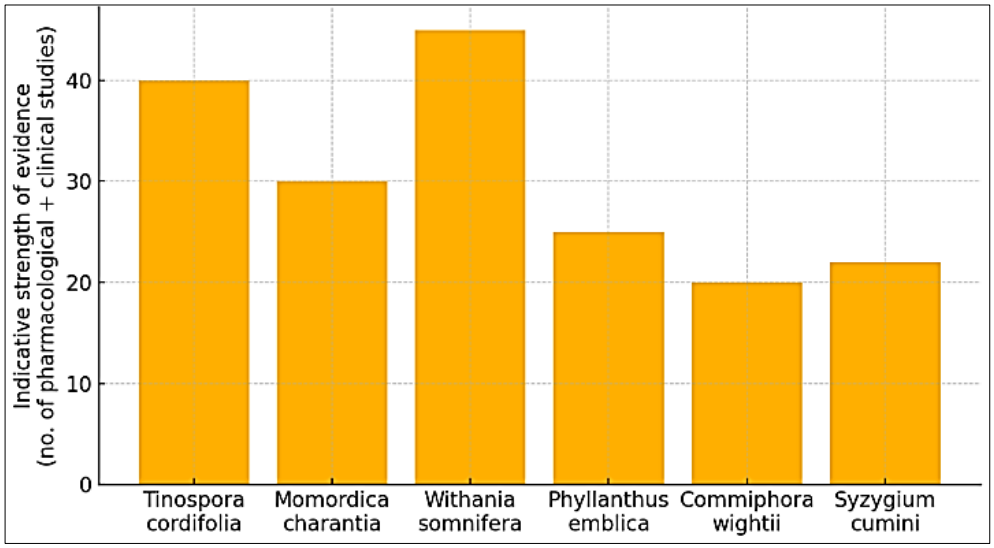

Fig 1: Indicative bar graph of relative strength of evidence (number of pharmacological and clinical studies) for selected plants used in lifestyle disorders

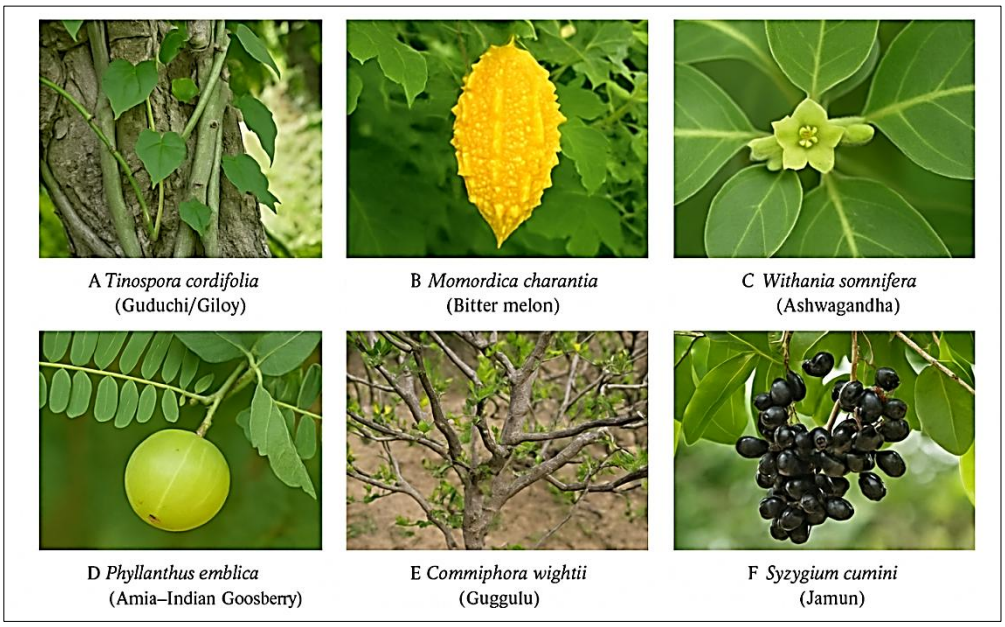

Fig 2: Representative photographs of key Ayurvedic plants used for lifestyle disorders

5. Discussion

5.1 Alignment between ethnobotanical knowledge and scientific evidence

The reviewed literature demonstrates substantial concordance between ethnobotanical claims, classical Ayurvedic indications and modern pharmacological data for several plants. For example, *T. cordifolia* is praised as a *Rasayana* and antidiabetic drug in classical texts; ethnobotanical surveys across India report its use for "sugar disease," fatigue and recurrent infections; experimental work confirms antidiabetic, antioxidant and immunomodulatory effects; and clinical trials show improved glycaemic control and acceptable safety in humans (Panchabhai *et al.*, 2008; Mishra *et al.*, 2015; Gupta *et al.*, 2024) [23, 7, 14].

Similarly, *M. charantia* is consumed as food and medicine in many communities and is a classical antidiabetic vegetable in Ayurveda; modern studies support its hypoglycaemic and hypolipidaemic properties, although clinical data are more variable (Patil *et al.*, 2011; Modak *et al.*, 2007; Patil *et al.*, 2011 - experimental studies) [11, 9].

For stress-linked lifestyle disorders, *W. somnifera* stands out as a plant where ethnopsychological claims of "strength, stamina and calmness" have been systematically validated through high-quality randomized trials and meta-analyses, showing meaningful reductions in stress, anxiety and cortisol (Arumugam *et al.*, 2024; Cheah *et al.*, 2021; Mikulska *et al.*, 2023) [2, 3, 25].

5.2 Implications for management of lifestyle disorders

From an Ayurvedic-ethnobotanical perspective, management strategies for lifestyle disorders can be conceptualized at three levels:

1. **Primordial and primary prevention (Ayurvedic lifestyle and food-based ethnobotany).**

- Promotion of regionally appropriate diets rich in bitter and astringent vegetables (e.g. *M. charantia*, ridge

gourd, cucumber), whole grains and spices with *Deepana-Pachana* effects.
- Daily and seasonal regimens (Dinacharya, Ritucharya) to maintain *Agni*, biorhythms and mental balance (Yenepoya Guideline, 2024; Jaims Metabolic Syndrome Review, 2025).

2. Early disease and metabolic risk (single herbs and simple formulations).
- Use of household remedies (e.g. fenugreek seed powder, neem leaf juice, *Guduchi* decoction) under guidance to address early dysglycaemia, dyslipidaemia and overweight.
- Incorporation of adaptogens like Ashwagandha in individuals with high stress and early metabolic derangement (Arumugam *et al.*, 2024; Mikulska *et al.*, 2023) [2, 25].

3. Established disease (polyherbal formulations and integrated protocols).
- Use of standardised polyherbal formulations such as *Triphala*, *Trikatu*, *Guggulu* preparations and disease-specific decoctions (e.g. *Nisha-Amalaki*, *Vijaysar*-based formulations), combined with Panchakarma in selected cases (Palla *et al.*, 2021; Yenepoya Guideline, 2024; Jaims Metabolic Syndrome Review, 2025) [10].
- The clinical evidence for these is encouraging but still emerging, and they should be used under qualified supervision, particularly when combined with allopathic medicines.

5.3 Methodological limitations and challenges
Several methodological issues limit the strength of current evidence:
- **Heterogeneity of preparations:** Many studies use local or proprietary formulations with variable composition, extraction methods and doses, complicating comparison and replication (Palla *et al.*, 2021) [10].
- **Short trial duration and small sample sizes:** Most RCTs last 4-12 weeks and involve fewer than 100 participants, inadequate to assess long-term cardiometabolic outcomes or rare adverse events (Arumugam *et al.*, 2024; Mishra *et al.*, 2015) [2, 7].
- **Limited reporting of herb-drug interactions:** Many participants continue standard antidiabetic or antihypertensive medications, yet systematic monitoring of interactions is rare.
- **Under-representation of complex Ayurvedic protocols:**Panchakarma and individualized therapies, which might have larger effects in real-world practice, are difficult to evaluate in standard trial designs (Langhana Metabolic Syndrome Review, 2025).

5.4 Ethical and conservation concerns
Increased interest in herbal antidiabetic and anti-obesity products risks over-harvesting of wild populations of plants such as *T. cordifolia* and *C. wightii* and possible biopiracy of community knowledge (Ghosh *et al.*, 2024; Modak *et al.*, 2007) [5, 9]. Ethical documentation must ensure:
- prior informed consent of communities;
- recognition and benefit-sharing for knowledge holders;
- policies for sustainable harvesting and cultivation;
- Transparent labelling and quality control to protect consumers.

5.5 Future research directions
Based on the above synthesis, priority directions include:
1. Standardized, multi-centre RCTs of high-priority plants (e.g. *T. cordifolia*, *M. charantia*, *P. emblica*, *W. somnifera*) in clearly defined patient groups with long-term follow-up.
2. Network pharmacology and systems biology to model multi-target effects consistent with Ayurveda's holistic approach.
3. Pharmacovigilance and real-world evidence studies embedded in Ayurvedic clinics to capture safety and effectiveness in routine practice.
4. Community-based participatory ethnobotany to continue documenting under-reported plants and ensure equitable involvement of knowledge holders.

6. Conclusion
Ethnobotanical knowledge in Ayurveda offers a rich, time-tested resource for the prevention and management of lifestyle disorders. Documentation efforts over the last decade, including national-scale databases and focused tribal surveys, reveal hundreds of plant species used traditionally for diabetes and cardiometabolic risk, many of which are also described in classical Ayurvedic texts (Patil *et al.*, 2011; Ghosh *et al.*, 2024; Modak *et al.*, 2007) [11, 5, 9].
Pharmacological and clinical studies support the ethnobotanical and Ayurvedic claims for several key plants, notably *Tinospora cordifolia*, *Momordica charantia*, *Syzygium cumini*, *Trigonella foenum-graecum*, *Phyllanthus emblica*, *Commiphora wightii* and *Withania somnifera*, demonstrating antidiabetic, hypolipidaemic, hepatoprotective, immunomodulatory and adaptogenic effects. However, methodological limitations, standardization challenges and limited long-term safety data prevent their full integration into mainstream guidelines.
A systematic, ethically grounded framework linking community-based documentation, Ayurvedic theory, mechanistic research and rigorous clinical trials can help convert this ethnobotanical wealth into scientifically validated, culturally resonant interventions. Such integration has the potential to provide affordable, holistic and sustainable options for tackling the growing burden of lifestyle disorders in India and beyond.

7. Acknowledgments
The author/s gratefully acknowledges traditional knowledge holders, Ayurvedic physicians and researchers whose work in documentation and validation of medicinal plants has made this synthesis possible.

8. Conflicts of Interest: The author declares no conflicts of interest related to this review.

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