RESEARCH PAPER

Ayurveda in Metabolic Syndrome: Current Evidence, Clinical Limitations, and Future Research Directions – A Narrative Review

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ABSTRACT

Background:
Metabolic syndrome (MetS) is a cluster of risk factors: central obesity, raised blood pressure, dysglycaemia, high triglycerides and low HDL cholesterol. It increases the risk of type 2 diabetes and cardiovascular disease. Ayurveda looks at the same ground through concepts such as *Sthaulya*, *Prameha*, *Santarpana-janya vyadhi*, *Agni* and *Meda-dhatu*, together with diet and lifestyle regulation.

Objective:
To review the clinical evidence for selected Ayurvedic interventions in MetS and its components, to show where that evidence is weak, and to set out research priorities.

Methods:
Narrative review of randomized trials, systematic reviews and safety reports on selected Ayurvedic botanicals and Panchakarma. No systematic search, pooled analysis or formal risk-of-bias assessment was done.

Results:
The evidence differs widely between interventions. Curcumin has a comparatively larger clinical evidence base among the interventions discussed. A nine-month trial in prediabetes and several meta-analyses report benefit for selected outcomes, although results vary with formulation, dose and population. A systematic review of Triphala trials found favourable changes in some lipid and body-measurement outcomes, but the studies were small and heterogeneous. Controlled trials of Guggulu have not shown a dependable lipid-lowering effect, and reports of liver injury linked to *Tinospora cordifolia* make safety monitoring essential. For Panchakarma, the evidence is too thin to say whether it works in MetS or whether any benefit lasts.

Conclusion:
Ayurveda offers a culturally familiar, lifestyle-centred framework that may serve as an adjunct to standard care. Efficacy and safety have to be shown intervention by intervention, not assumed. Future trials need authenticated, standardized products, prespecified outcomes, suitable comparators, transparent reporting and longer follow-up. Ayurvedic care should not replace evidence-based treatment of hypertension, dyslipidaemia, diabetes or cardiovascular risk.

Keywords: metabolic syndrome; Ayurveda; Sthaulya; Prameha; curcumin; Triphala; clinical research; herbal safety; integrative medicine

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1. INTRODUCTION

Metabolic syndrome (MetS) is not a single disease but a cluster: a larger waist, raised triglycerides, low HDL cholesterol, higher blood pressure and raised fasting glucose. Under the harmonized definition, a person has MetS when any three of these five features are present, with waist thresholds set for the population concerned [1]. The cluster matters because it travels with insulin resistance and predicts later type 2 diabetes mellitus (T2DM) and cardiovascular disease. Visceral fat, inactivity, diet, genetic susceptibility, poor sleep and social and environmental conditions all feed into it [2,3].

Standard management aims to lower overall cardiometabolic risk. It rests on sustained changes in diet and physical activity, weight management and, where indicated, drugs for blood pressure, lipids and glucose. These measures have solid evidence behind them, and unproven therapies should not push them aside. Even so, long-term care is hard in practice. Adherence, cost, treatment burden and the effort of lasting behaviour change all get in the way.

Ayurveda describes states of excess and poorly regulated metabolism in its own terms. The ideas most often brought into this discussion are Sthaulya (obesity), Prameha (a group of urinary and metabolic disorders), Santarpana-janya vyadhi (diseases that classical texts attribute to over-nourishment), Agni, Ama, Meda-dhatu and Srotas. They belong to a different explanatory system, so they should not be read as direct equivalents of insulin resistance, inflammation or microvascular dysfunction. Their value today is better judged by asking clear clinical questions, describing interventions openly and measuring outcomes.

This review looks at the evidence for selected Ayurvedic botanicals and formulations used in metabolic care. It tries to keep four things apart: traditional rationale, mechanistic hypothesis, clinical finding and established treatment recommendation. It also covers safety and the research design needed for responsible integration with standard care.

2. REVIEW APPROACH

This is a narrative review, not a systematic one. It draws on published randomized trials, systematic reviews and safety reports for the interventions discussed, giving priority to studies that measured metabolic outcomes or reported harms. No systematic search, pooled analysis or formal risk-of-bias assessment was carried out, and studies were not chosen under a prespecified protocol. Some relevant work may therefore have been missed. The conclusions are best read as a critical appraisal of the evidence, not as a complete count of it. A systematic review would need a registered protocol, a reproducible search and PRISMA-style reporting.

3. AYURVEDIC CONCEPTUAL FRAMEWORK

3.1 Classical concepts and how to interpret them today

Classical descriptions of Sthaulya and Santarpana-janya disorders centre on patterns of nourishment, activity, tissue metabolism and functional imbalance. Agni and Ama are traditional ways of talking about impaired digestion and metabolism, while Meda-dhatu and Srotas give a vocabulary for adiposity and the body's channels. Within Ayurvedic practice these ideas can shape individual assessment and lifestyle counselling. They are not, however, validated substitutes for measuring waist circumference, blood pressure, fasting glucose, HbA1c or lipids. If they are to be used in research, studies must state how each classical assessment is operationalized and test its inter-rater reliability, construct validity and added clinical value.

3.2 Ahara and Vihara

Diet, physical activity, sleep and daily routine sit at the centre of modern cardiometabolic prevention and of much Ayurvedic practice. In a trial these components have to be described precisely: the dietary advice, energy targets where relevant, how often and how hard participants exercise, sleep guidance, adherence measures and any co-interventions. The reason is simple. Lifestyle change alone can move weight, glucose, blood pressure and lipids. When a multi-component Ayurvedic programme is tested, the protocol should separate the contribution of each part wherever possible, so that a change is not credited to

one herb or procedure when diet and activity may have done much of the work.

4. CLINICAL EVIDENCE FOR SELECTED INTERVENTIONS

What follows is evidence for particular preparations and ingredients. It is not proof that Ayurveda as a whole works in MetS. Many studies enrol people with diabetes, obesity or dyslipidaemia rather than participants who meet one uniform MetS definition. Formulation, dose, duration, comparator, baseline risk and outcome definitions all vary, so results cannot be lined up neatly side by side.

4.1 *Curcuma longa* and curcumin

Curcumin, a constituent of *Curcuma longa* (Haridra), is among the best-studied botanicals in this area. In a randomized, double-blind, placebo-controlled trial of 240 people with prediabetes, none of those taking a curcumin extract progressed to T2DM over nine months, compared with about 16% of the placebo group [4]. The result is striking, but it belongs to one extract in one selected population. It should not be stretched to culinary turmeric, to other Ayurvedic preparations or to the treatment of established MetS.

Meta-analyses of randomized trials in MetS report improvement in some glycaemic, lipid, anthropometric or inflammatory outcomes, along with considerable heterogeneity for several of them [5,6]. One 2023 analysis pooled 13 trials with 785 participants, yet treatment lasted only 4 to 12 weeks [6]. Bioavailability, dose and study population differ from trial to trial, which makes interpretation harder. Proposed mechanisms such as PPAR-γ activation or NF-κB inhibition rest mostly on experimental work. They should be described as hypotheses, not as proof of clinical benefit.

4.2 Triphala

Triphala combines *Emblica officinalis* (syn. *Phyllanthus emblica*), *Terminalia chebula* and *Terminalia bellirica*. A systematic review of 12 studies with 749 patients found significant falls in LDL cholesterol, total cholesterol and triglycerides in six studies, and lower body weight, BMI and waist circumference in five trials of people with obesity [7]. Fasting glucose fell in people with diabetes but not in those without it, and no serious adverse events were reported.

The evidence is still uneven. The number and design of trials differed by outcome, and the review cannot show that Triphala works as a stand-alone treatment for MetS or that it prevents cardiovascular events. Future trials should define the formulation, verify botanical identity and chemical quality, report adherence and adverse events, and follow participants long enough for the results to matter clinically.

4.3 Guggulu and guggulipid

Commiphora mukul (Guggulu) has long been used in Ayurvedic management of lipid disorders, and guggulsterones acting on bile-acid signalling offer a plausible mechanism. Plausibility is not efficacy, though, and the trials disagree. In a randomized, placebo-controlled trial of guggulipid in people with hypercholesterolaemia, LDL cholesterol rose by 4% to 5% in the treated groups while it fell by 5% on placebo, and six treated participants developed a hypersensitivity rash [8]. A later placebo-controlled trial of Guggulu with Triphala, in 90 people with hypercholesterolaemia, found no better effect than placebo on total or LDL cholesterol, BMI or waist circumference after three months [9].

Older trials from India did report lipid reductions. One 24-week trial of guggulipid added to dietary therapy found total and LDL cholesterol falling by roughly 12% [10]. Taken together, the literature is mixed. Guggulu cannot be described as reliably lowering LDL cholesterol, and it should not replace guideline-directed lipid-lowering therapy.

4.4 *Tinospora cordifolia* (Guduchi/Giloy)

Tinospora cordifolia has been studied for several biological activities, including possible effects on glucose regulation, but there is little solid clinical evidence for its use in MetS specifically. Safety is the bigger concern. A retrospective multicentre study from India described 43 patients with liver injury temporally linked to Giloy use, some of whom presented with acute liver failure [11]. The interpretation of these reports has been debated, including questions about plant identification and causal attribution [12,14]. These concerns reinforce the need to distinguish a temporal association from definitive proof of causality.

These reports are observational. They do not measure risk for every product or user, and causality in individual cases has been debated. They do, however, rule out any blanket claim that the herb is inherently safe. In practice and in trials, product identification, review of other medicines, adverse-event surveillance and liver testing deserve real attention.

4.5 Nisha-Amalaki and other polyherbal formulations

Nisha-Amalaki, usually described as a combination of *Curcuma longa* and *Phyllanthus emblica*, is used traditionally in glycaemic disorders. Each formulation needs to be judged on its own evidence, and it matters whether that evidence comes from laboratory work, animal studies or human trials. Enzyme inhibition and other laboratory findings can generate hypotheses, but they cannot show better HbA1c, fewer diabetic complications or safety in routine care. Clinical studies should state ingredient proportions, manufacturing process, batch fingerprint, dose, duration, concurrent medicines and prespecified endpoints. Proprietary and

classical polyherbal products should be held to the same standard.

4.6 Panchakarma procedures

Virechana, Basti and other Panchakarma procedures are sometimes built into programmes for weight and metabolic management. Robust evidence on their comparative effectiveness for MetS, lasting weight loss, cardiovascular risk reduction or prevention of T2DM is still lacking. Studies of whole programmes are hard to interpret because procedures are usually combined with dietary restriction, massage, exercise or other co-interventions. Statements that Panchakarma "detoxifies" the body, "resets" metabolism or acts through the microbiome should not be presented as established fact without direct, reproducible evidence. Trials should define the procedure, practitioner qualifications, setting, co-interventions, adverse-event monitoring and comparator, and should account for risks such as dehydration and electrolyte disturbance where relevant.

Table 1. Summary of the evidence for selected interventions

Intervention	What the evidence shows	Main limitations	How to read it
Curcumin / *Curcuma longa*	A randomized trial and meta-analyses report gains in selected outcomes in specific populations [4–6].	Preparations and bioavailability differ; trials are heterogeneous and short; not the same as culinary turmeric.	Promising, not definitive. Claim only what was tested: that preparation, that outcome.
Triphala	A systematic review found favourable lipid or body-measurement changes in some trials [7].	Small, variable studies; mixed outcomes; long-term clinical outcomes unknown.	Needs standardized, adequately powered trials.
Guggulu / Guggulipid	Controlled trials show no consistent lipid benefit; one found higher LDL than placebo; older trials were positive [8–10].	; hypersensitivity reactions reported.	lowering or use as a substitute for established lipid therapy.
Tinospora cordifolia	Little evidence of MetS-specific efficacy.	Case series and a multicentre study raise concern about herb-induced liver injury [11,12].	Assess safety carefully; avoid blanket claims that it is safe.
Panchakarma	A few small studies test procedures inside complex lifestyle programmes.	Too little robust evidence on durable MetS or cardiovascular outcomes; co-interventions confound results.	Investigational for MetS claims; describe procedures and harms openly.

5. SAFETY, QUALITY AND INTERACTIONS

Safety belongs at the centre of any evaluation of Ayurvedic interventions, especially in people with diabetes, hypertension, dyslipidaemia, chronic kidney disease, liver disease or a long list of medicines. The risks include herb–drug interactions, idiosyncratic liver injury, allergic reactions, contamination, adulteration and variation in ingredient identity or strength. In a study of Ayurvedic medicines bought over the internet, whether made in the United States or in India, about one in five products contained detectable lead, mercury or arsenic [13]. This estimate applies to the products tested in that study and should not be generalized to all Ayurvedic medicines. That finding cannot be applied to every product, but it shows why reliable manufacturing, testing and traceability matter.

Clinical trials should record botanical authentication, plant part, extraction method, ingredient ratios, batch number, chemical fingerprint, contaminant testing,

storage conditions and stability. Adverse events should be actively asked about and graded, not noted only when volunteered. Baseline and follow-up laboratory tests should suit the intervention and the population. Participants must be told not to stop prescribed antihypertensive, glucose-lowering, lipid-lowering or other essential medicines without speaking to their treating clinician.

6. LIMITATIONS OF THE CURRENT EVIDENCE

A handful of problems recur across this literature. Many studies are small, single-centre and short, so durability, rare harms and cardiovascular outcomes remain unknown. Botanical identity, formulation, dose, manufacturing and lifestyle advice differ from trial to trial. Surrogate outcomes are measured far more often than incident diabetes, cardiovascular events, quality of life or lasting functional benefit. Reporting of allocation concealment, blinding, attrition, trial registration and adverse events is often patchy. There is also a logical gap at both ends: trials of single ingredients cannot validate a whole Ayurvedic treatment package, while trials of multi-component packages cannot say which component did the work.

Personalized care is a defining feature of Ayurvedic practice, but when it is evaluated scientifically the personalization has to be documented so that others can reproduce it. Prakriti assessment and other classical constructs need clear operational definitions, demonstrated reliability and prespecified analyses before they can be trusted for stratifying participants or choosing treatment in trials.

7. FUTURE RESEARCH PRIORITIES

7.1 Standardized and transparent products

Research should use authenticated raw materials and standardized formulations, with quality-control data that others can see. Chemical characterization, batch-to-batch consistency, contaminant testing and stability data belong alongside the clinical protocol. Where a product is a complex mixture, investigators should list every ingredient and manufacturing step in enough detail for independent replication.

7.2 Better trial design

Trials should be registered in advance, adequately powered and reported according to CONSORT, including the extension for herbal interventions where it applies. Eligibility criteria, allocation method, comparator, co-interventions, adherence, outcome hierarchy, statistical analysis, handling of missing data and adverse-event procedures should all be fixed beforehand. Pragmatic trials suit whole-system programmes, while explanatory trials can test single formulations. Either way, the report should separate efficacy from effectiveness and avoid implying causation from uncontrolled before-and-after changes.

7.3 Meaningful outcomes and longer follow-up

Studies should measure the standard outcomes (waist circumference, body weight, blood pressure, fasting glucose, HbA1c, triglycerides, HDL cholesterol and medication changes) with methods and time points set in advance. Where feasible, longer follow-up should assess whether effects persist, and should capture incident T2DM, cardiovascular outcomes, quality of life and cost-effectiveness. Biomarkers and mechanistic endpoints can add to these measures but should not replace outcomes that matter to patients.

7.4 Mechanistic and translational studies

Metabolomics, pharmacokinetics, pharmacodynamics, microbiome analysis and similar approaches may help explain biological effects, provided hypotheses are stated in advance and results are read cautiously. A mechanistic signal should be tied to exposure at realistic doses and, in the end, to clinical outcomes. Findings from cell and animal models must be kept clearly apart from evidence in humans.

7.5 Integrative, person-centred care

Future work should test whether structured Ayurvedic lifestyle support, added to standard care, improves engagement, adherence, patient experience and metabolic outcomes. Studies should include diverse populations and report socioeconomic context, acceptability and treatment burden. Integration should rest on demonstrated benefit, honest uncertainty, patient preference and shared decision-making, not on the assumption that traditional and biomedical explanations are interchangeable.

8. DISCUSSION

Some Ayurvedic botanicals and formulations deserve further study for selected metabolic outcomes, but the strength of the evidence varies a great deal from one intervention to the next. Curcumin has the clearest clinical record of those discussed, with a prevention trial and several meta-analyses on metabolic endpoints, yet its findings remain specific to the preparation and population studied. Triphala shows preliminary promise for some body-measurement and lipid outcomes, and stronger trials are needed. Controlled studies of Guggulu, by contrast, do not support confident claims of consistent lipid lowering. The Tinospora safety signal is a reminder that long traditional use does not remove the need for pharmacovigilance. And the evidence for Panchakarma in MetS is far too limited to support claims of proven superiority or long-term cardiometabolic protection.

Together these findings support a cautious integrative position. Ayurvedic concepts can give patients and practitioners a culturally meaningful way to talk about diet, activity, routine and individualized care, but claims of efficacy must rest on clinical data. The

comparison with conventional medicine should also be fair. Standard treatment should not be portrayed as inherently single-target or as carrying unavoidable toxicity; guideline-directed therapy often reduces risk substantially, and its benefits and harms need to be weighed for each patient. The most useful research question is whether a clearly specified Ayurvedic intervention adds measurable benefit, acceptable safety and value to appropriate standard care.

9. CONCLUSION

Ayurveda offers a long-standing framework for thinking about obesity and metabolic disorders, and a few interventions, notably curcumin-containing preparations and Triphala, have produced clinical evidence that justifies further testing. The findings so far are heterogeneous, and they do not establish all Ayurvedic medicines or Panchakarma procedures as effective treatments for metabolic syndrome. Guggulu is not consistently supported by controlled trials, and *Tinospora cordifolia*-associated liver injury is a serious safety concern. Progress depends on standardized products, rigorous and transparent trials, meaningful outcomes, long-term safety monitoring and responsible integration with evidence-based cardiometabolic care. Ayurveda is best evaluated as a set of specific interventions, not as a single, uniformly effective therapy.

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REFERENCES

1. Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circulation. 2009;120(16):1640-1645. doi:10.1161/CIRCULATIONAHA.109.192644.
2. Saklayen MG. The global epidemic of the metabolic syndrome. Curr Hypertens Rep. 2018;20(2):12. doi:10.1007/s11906-018-0812-z.
3. Hotamisligil GS. Inflammation and metabolic disorders. Nature. 2006;444(7121):860-867. doi:10.1038/nature05485.
4. Chuengsamarn S, Rattanamongkolgul S, Luechapudiporn R, Phisalaphong C, Jirawatnotai S. Curcumin extract for prevention of type 2 diabetes. Diabetes Care. 2012;35(11):2121-2127. doi:10.2337/dc12-0116.
5. Azhdari M, Karandish M, Mansoori A. Metabolic benefits of curcumin supplementation in patients with metabolic syndrome: a systematic review and meta-analysis of randomized controlled trials. Phytother Res. 2019;33(5):1289-1301. doi:10.1002/ptr.6323.
6. Qiu L, Gao C, Wang H, Ren Y, Li J, Li M, et al. Effects of dietary polyphenol curcumin supplementation on metabolic, inflammatory, and oxidative stress indices in patients with metabolic syndrome: a systematic review and meta-analysis of randomized controlled trials. Front Endocrinol (Lausanne). 2023;14:1216708. doi:10.3389/fendo.2023.1216708.
7. Phimarn W, Sungthong B, Itabe H. Effects of Triphala on lipid and glucose profiles and anthropometric parameters: a systematic review. J Evid Based Integr Med. 2021;26:2515690X211011038. doi:10.1177/2515690X211011038.
8. Szapary PO, Wolfe ML, Bloedon LT, Cucchiara AJ, DerMarderosian AH, Cirigliano MD, et al. Guggulipid for the treatment of hypercholesterolemia: a randomized controlled trial. JAMA. 2003;290(6):765-772. doi:10.1001/jama.290.6.765.
9. Donato F, Raffetti E, Toninelli G, Festa A, Scarcella C, Castellano M; TRIGU Project Working Group. Guggulu and Triphala for the treatment of hypercholesterolaemia: a placebo-controlled, double-blind, randomised trial. Complement Med Res. 2021;28(3):216-225. doi:10.1159/000510985.
10. Singh RB, Niaz MA, Ghosh S. Hypolipidemic and antioxidant effects of Commiphora mukul as an adjunct to dietary therapy in patients with hypercholesterolemia. Cardiovasc Drugs Ther. 1994;8(4):659-664. doi:10.1007/BF00877420.
11. Kulkarni AV, Hanchanale P, Prakash V, Kalal C, Sharma M, Kumar K, et al. Tinospora cordifolia (Giloy)-induced liver injury during the COVID-19 pandemic: multicenter nationwide study from

India. Hepatol Commun. 2022;6(6):1289-1300. doi:10.1002/hep4.1904.
12. Nagral A, Rudra OS, Menezes S, Menon S, Shailajan S, Mallakmir S, et al. Herb-induced liver injury: a guide to approach. Lessons from the Tinospora cordifolia (Giloy) case series story. J Clin Exp Hepatol. 2023;13(2):360-371. doi:10.1016/j.jceh.2022.11.001.
13. Saper RB, Phillips RS, Sehgal A, Khouri N, Davis RB, Paquin J, et al. Lead, mercury, and arsenic in US- and Indian-manufactured Ayurvedic medicines sold via the Internet. JAMA. 2008;300(8):915-923. doi:10.1001/jama.300.8.915.
14. Devarbhavi H. Response to Tinospora cordifolia (Giloy)-induced liver injury during the COVID-19 pandemic: multicenter nationwide study from India. Hepatol Commun. 2022;6(10):2995-2996. doi:10.1002/hep4.1989.