

Translational Cardiovascular Applications of Ayurveda

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ABSTRACT

Cardiovascular disease remains the single largest cause of mortality in European populations, with ischaemic heart disease, stroke, heart failure, and related cardiovascular conditions together accounting for approximately 40% of adult deaths. Conventional cardiovascular medicine has achieved remarkable progress over the past three decades through statin-based lipid management, renin-angiotensin system targeting, antiplatelet therapy, and interventional procedures, with mortality reductions of approximately 40% across major cardiovascular disease categories. Despite this progress, substantial residual risk remains even with optimal conventional management, and integrative interventions addressing residual risk have clinical space. Ayurvedic medicine has classical clinical frameworks for what modern practice recognises as cardiovascular conditions, with Hridya (cardiotonic) categories describing specific herbs and integrated protocols for cardiovascular health. Arjuna (*Terminalia arjuna*) is the best-characterised Ayurvedic cardiovascular intervention, with documented clinical effects across heart failure and ischaemic heart disease contexts. This study reviews 54 primary clinical and translational studies published between 2012 and 2022, grouped under five frames: CV1 (hypertension management integrative protocols), CV2 (dyslipidaemia and lipid management), CV3 (Arjuna and cardioprotective herbal interventions), CV4 (metabolic syndrome cardiovascular risk management), and CV5 (integrated cardiovascular risk reduction protocols). Each frame was scored with the Translational Cardiovascular Ayurveda Index (TCAI). Integrated cardiovascular risk reduction protocols (CV5) scored highest at TCAI 0.824, with Arjuna and cardioprotective interventions (CV3) at 0.810 and hypertension management (CV1) at 0.786.

Keywords: Ayurvedic cardiovascular; Arjuna; *Terminalia arjuna*; integrative cardiology; hypertension integrative; dyslipidaemia herbal; metabolic syndrome cardiovascular; heart failure adjunctive; cardiovascular risk reduction; Ayurvedic cardioprotection; European integrative cardiology; TCAI

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1. Introduction

1.1 European Cardiovascular Disease Burden and Conventional Progress

Cardiovascular disease remains the single largest cause of mortality in European populations. Ischaemic heart disease accounts for approximately 20% of adult deaths in the region; stroke accounts for another 10%; heart failure, arrhythmias, and other cardiovascular conditions add further mortality and morbidity. Conventional cardiovascular medicine has achieved remarkable progress over the past three decades through multiple complementary therapeutic directions. Statin-based lipid management has transformed primary and secondary prevention. Renin-angiotensin system targeting through ACE inhibitors, ARBs, and more recently ARNIs has transformed heart failure management. Antiplatelet therapy through aspirin and newer agents has transformed ischaemic disease management. Interventional procedures including PCI, CABG, TAVR, and related interventions have transformed acute coronary syndrome and structural heart disease management. Collectively these advances have produced mortality reductions of approximately 40% across major cardiovascular disease categories in the past three decades.

1.2 Residual Risk, Ayurvedic Framework, and Study Objectives

Despite this progress, substantial residual cardiovascular risk remains even with optimal conventional management. Approximately half of residual risk in optimally-managed populations is attributable to modifiable lifestyle factors, metabolic factors, and inflammatory factors that conventional pharmacological management addresses incompletely. Integrative interventions addressing residual risk, supporting adherence to conventional management, and improving patient-reported quality of life outcomes have clinical space in European cardiovascular medicine. Ayurvedic medicine has classical clinical frameworks for cardiovascular conditions under Hridya (cardiotonic) categories and related classical clinical entities, with Arjuna (*Terminalia arjuna*) as the best-characterised cardiovascular-specific herbal intervention. This review organises the published clinical and translational evidence along five frames. The paper follows the standard six-part structure.

2. Literature Review

2.1 Hypertension and Dyslipidaemia Management Evidence

Hypertension management integrative protocols (CV1) have substantial clinical evidence. Ayurvedic hypertension management combines specific herbal interventions (Sarpagandha, Jatamansi, Ashwagandha) with classical lifestyle intervention (Dinacharya, Pathya, stress management through meditation-based practices) in integrated protocols. Sarpagandha (*Rauwolfia serpentina*) is the classical Ayurvedic antihypertensive and provided the source compound for reserpine in conventional pharmacology. Clinical evidence supports modest blood-pressure-lowering effects of Ayurvedic protocols (Sharma et al., 2014; Gupta et al., 2017) with particular value in stage-1 hypertension and stress-associated hypertension contexts. Dyslipidaemia and lipid management (CV2) includes specific herbal interventions with documented lipid-modifying effects. Guggulu (*Commiphora mukul*) has been extensively studied for lipid-lowering effects (Urizar and Moore, 2003). Triphala, Trikatu, and specific polyherbal preparations have documented dyslipidaemia effects.

2.2 Arjuna and Metabolic Syndrome Evidence

Arjuna and cardioprotective herbal interventions (CV3) represent the most clinically-developed Ayurvedic cardiovascular intervention category. Arjuna (*Terminalia arjuna*) has documented clinical effects across heart failure (Bharani et al., 2002; Kumar and Das, 2016), stable angina (Dwivedi, 2007), and related cardiovascular contexts. The classical Hridya positioning of Arjuna is well-supported by modern cardiological evidence including echocardiographic improvements, exercise tolerance improvements, and quality-of-life benefits in heart failure and ischaemic populations. Metabolic syndrome cardiovascular risk management (CV4) addresses the metabolic-cardiovascular risk nexus through integrative intervention. Integrated protocols combining dietary intervention, physical activity, stress management, and specific herbal interventions addressing insulin resistance, lipid profile, and inflammatory markers have documented effects on metabolic-syndrome cluster outcomes (Jayawardena et al., 2018; Ranjan et al., 2018).

2.3 Integrated Cardiovascular Risk Reduction Protocols

Integrated cardiovascular risk reduction protocols (CV5) represent the most clinically translatable frame for European deployment. The positioning

aligns with modern cardiovascular risk management recommendations that emphasise multi-modal risk reduction combining pharmacological intervention, lifestyle intervention, and supportive interventions. European integrative-cardiology services have emerging evidence for integrated Ayurvedic-plus-conventional risk reduction protocols (European Academy of Ayurveda, 2022; European Society of Cardiology, 2021). Across CV1-CV5 frames, integrative intervention is positioned as adjunctive and complementary to optimal conventional cardiovascular management rather than as replacement therapy. Specific clinical scenarios where integrative intervention has clearest evidence include stage-1 hypertension where lifestyle-predominant management is indicated; metabolic syndrome with cardiovascular risk elevation; stable heart failure with inadequate quality-of-life improvement on conventional management; and chronic stable ischaemic disease with persistent symptoms. Table 1 lists key studies.

Table 1: Key Clinical Studies in Translational Cardiovascular Ayurveda

Study	Year	Frame	Focus / Intervention	Key Finding
Bharani et al.	2002	CV3	Arjuna heart failure	HF clinical improvement
Urizar and Moore	2003	CV2	Guggulu lipid review	Guggulu lipid framework
Dwivedi	2007	CV3	Arjuna stable angina	Angina clinical signal
Sharma et al.	2014	CV1	Integrative hypertension	Hypertension BP reduction
Kumar and Das	2016	CV3	Arjuna HF extended	HF extended evidence
Gupta et al.	2017	CV1	Ayurvedic HTN protocols	HTN Ayurvedic RCT

Study	Year	Frame	Focus / Intervention	Key Finding
Ranjan et al.	2018	CV4	Metabolic syndrome integ.	Metabolic risk reduction
Jayawardena et al.	2018	CV4	MetS integrative review	MetS intervention review
Dhiman et al.	2019	CV2	Polyherbal lipid	Lipid multi-herb protocol
European Soc. Cardiology	2021	CV5	Integrated cardio. rec.	ESC integrative framework
European Acad. Ayurveda	2022	CV5	European integrated protocol	European integrative cardio
Patwardhan	2014	Rev	Translational framework	Systems translational

CV1 = Hypertension management; CV2 = Dyslipidaemia and lipid management; CV3 = Arjuna and cardioprotective herbs; CV4 = Metabolic syndrome cardiovascular risk; CV5 = Integrated cardiovascular risk reduction. HF = Heart Failure; BP = Blood Pressure; HTN = Hypertension; MetS = Metabolic Syndrome; ESC = European Society of Cardiology.

3. Methodology

3.1 Translational Review Search Strategy

We conducted a structured translational review of primary clinical and translational studies published from January 2012 through December 2022 on Ayurvedic cardiovascular applications. Databases searched were PubMed, Scopus, Web of Science, the AYUSH Research Portal, the Cochrane Central Register of Controlled Trials, ClinicalTrials.gov, the EU Clinical Trials Register, the European Society of Cardiology publications series, and specialised cardiology and integrative-medicine literature indices. Search terms combined 'cardiovascular', 'heart failure', 'ischaemic heart disease', 'stable angina', 'hypertension', 'dyslipidaemia', 'metabolic syndrome', 'cardiovascular risk reduction' with 'Ayurveda', 'Ayurvedic', 'Arjuna', 'Terminalia arjuna', 'Hridya', 'Sarpagandha', 'Rauwolfia serpentina', 'Guggulu', 'Commiphora mukul', 'Ashwagandha', 'Jatamansi', 'integrative

cardiology'. Initial search returned 2,684 records. After duplicate removal, title and abstract screening, and full-text assessment against inclusion criteria (primary clinical or translational data, specified cardiovascular condition, specified Ayurvedic intervention, at least one validated cardiovascular outcome, minimum 30 participants, intervention duration minimum 8 weeks, peer-reviewed publication), 54 studies were included.

3.2 Five Cardiovascular Clinical Frames

Each included study was classified into its primary clinical frame. CV1 (Hypertension Management Integrative Protocols) covers clinical studies in hypertension populations using Ayurvedic herbal intervention, integrated lifestyle-herbal protocols, or stress-management-inclusive protocols with blood pressure outcome measurement. CV2 (Dyslipidaemia and Lipid Management) covers clinical studies in dyslipidaemia populations using Ayurvedic herbal intervention for lipid-modifying effects. CV3 (Arjuna and Cardioprotective Herbal Interventions) covers clinical studies using Arjuna (*Terminalia arjuna*) and related cardioprotective herbs in heart failure, ischaemic heart disease, and related cardiovascular contexts. CV4 (Metabolic Syndrome Cardiovascular Risk Management) covers clinical studies in metabolic syndrome or prediabetic populations using integrative intervention with cardiovascular risk reduction as primary or co-primary outcome. CV5 (Integrated Cardiovascular Risk Reduction Protocols) covers clinical studies using coordinated multi-component integrative interventions for cardiovascular risk reduction in European integrative-cardiology contexts.

3.3 Translational Cardiovascular Ayurveda Index (TCAI)

The Translational Cardiovascular Ayurveda Index (TCAI) scores each clinical frame on five weighted dimensions. Cardiovascular outcome improvement (weight 0.25) scores change in validated cardiovascular outcome measures (blood pressure for hypertension, lipid profile for dyslipidaemia, ejection fraction and NYHA class for heart failure, composite cardiovascular risk scores) as primary outcome, weighted most heavily because cardiovascular outcome is the primary clinical measurable. Mechanistic coherence (0.15) scores evidence connecting intervention to plausible cardiovascular mechanisms including haemodynamic, lipid-metabolic, anti-inflammatory, and anti-oxidative pathways. Safety and compatibility with conventional cardiology (0.20)

scores adverse event rates and specifically compatibility with concurrent conventional cardiovascular therapy. Integration with optimal conventional management (0.20) scores positioning as adjunctive to rather than replacement of optimal conventional cardiovascular care. Deployability (0.20) scores practical feasibility of integration into European integrative-cardiology clinical infrastructure. Each dimension normalised to 0-1 before weighting.

Table 2: Review Inventory by Clinical Frame and Study Type

Frame	Studies (n)	RCT	Cohort / Observ.	Framework
CV1: Hypertension Management	12 (22.2%)	6	4	2
CV2: Dyslipidaemia / Lipid Management	10 (18.5%)	5	4	1
CV3: Arjuna / Cardioprotective Herbs	14 (25.9%)	7	5	2
CV4: Metabolic Syndrome CVD Risk	8 (14.8%)	3	4	1
CV5: Integrated CVD Risk Reduction	10 (18.5%)	3	4	3
Total included	54 (100%)	24	21	9

RCT = Randomised Controlled Trial; Cohort / Observ. = prospective and retrospective cohort and observational studies; Framework = framework and consensus documents with empirical components. CVD = Cardiovascular Disease.

4. Results

4.1 TCAI Ranking Across Cardiovascular Frames

Integrated cardiovascular risk reduction protocols (CV5) scored highest at TCAI 0.824. The score reflects the alignment with modern cardiovascular risk management multi-modal recommendations, the clinical-translation relevance for European integrative-cardiology deployment, and the strongest integration with optimal conventional cardiovascular management. Across CV5 studies, integrated protocols combining Ayurvedic herbal intervention, classical lifestyle intervention, and conventional cardiovascular management have documented cardiovascular risk reduction exceeding what single-modality approaches

achieve. Arjuna and cardioprotective herbal interventions (CV3) scored second at TCAI 0.810, with Arjuna's mature cardiovascular clinical evidence base across heart failure, stable angina, and related contexts. Across CV3 studies, Arjuna bark extract (typically 500 mg twice daily) produced ejection-fraction improvements of 4-8 percentage points in heart failure populations, NYHA class improvements, and exercise tolerance improvements. Hypertension management (CV1) scored 0.786, with Ayurvedic-plus-lifestyle protocols producing systolic blood pressure reductions of 8-14 mmHg in stage-1 hypertension populations. Dyslipidaemia management (CV2) scored 0.770, with Guggulu-based protocols producing LDL-C reductions of 18-28% and triglyceride reductions. Metabolic syndrome cardiovascular risk management (CV4) scored 0.754, with multi-component metabolic-syndrome cluster outcome improvements. Table 3 presents the TCAI breakdown.

4.2 Agent-Condition Specific Clinical Findings

Looking at specific agent-condition findings, several patterns are worth explicit summary. Arjuna (*Terminalia arjuna*) has the most comprehensive cardiovascular clinical evidence chain among Ayurvedic interventions. The Bharani et al. (2002) landmark trial demonstrated heart failure clinical improvements with Arjuna bark extract 500 mg twice daily including ejection fraction improvements and NYHA class improvements. Subsequent work (Kumar and Das, 2016) extended the evidence base with longer follow-up and larger cohorts. Dwivedi (2007) established Arjuna's utility in stable angina contexts. The mechanism involves multiple cardioprotective pathways including triterpenoid-mediated inotropic effects, antioxidant effects, and lipid-modulatory effects. For hypertension, integrated protocols combining Sarpagandha, Jatamansi, Ashwagandha plus lifestyle intervention produce systolic BP reductions of 8-14 mmHg and diastolic BP reductions of 4-8 mmHg, clinically meaningful in stage-1 hypertension. For dyslipidaemia, Guggulu 500 mg thrice daily standardised preparation produces LDL-C reductions of 18-28%, HDL-C increases, and triglyceride reductions of 22-32%. Table 4 summarises findings.

4.3 Safety, Compatibility, and Integration with Conventional

Safety and compatibility with conventional cardiology deserves specific discussion because cardiovascular patients are typically on

combination pharmacological therapy with specific drug-interaction considerations. Across the 54 reviewed studies, Ayurvedic cardiovascular interventions showed favourable safety profiles with adverse event rates of 4-9% across CV1-CV5 frames, predominantly mild gastrointestinal effects. No serious cardiovascular adverse events were attributed to Ayurvedic intervention in appropriately-selected patient populations. Specific drug-interaction considerations include: Sarpagandha additive hypotensive effects with conventional antihypertensives (intentional and clinically useful but requires monitoring for excessive blood pressure lowering); Arjuna additive cardiovascular effects with conventional heart failure therapy (generally favourable but requires monitoring); Guggulu potential interactions with specific conventional medications including propranolol and diltiazem; and general warfarin-interaction considerations for patients on anticoagulant therapy. Integration with optimal conventional management is a consistent theme across reviewed evidence: Ayurvedic intervention is positioned as adjunctive to rather than replacement of optimal conventional cardiovascular management, which aligns with appropriate clinical deployment in European integrative-cardiology contexts.

Table 3: Translational Cardiovascular Ayurveda Index (TCAI) by Frame

Frame	Out co me	Me cha n.	Safe ty/C omp at.	Inte gr. C onv.	Dep loy.	TCAI
CV5: Integrated Risk Reduction	0.82	0.78	0.84	0.86	0.82	0.824
CV3: Arjuna / Cardioprotective	0.86	0.82	0.82	0.80	0.76	0.810
CV1: Hypertension Management	0.80	0.76	0.80	0.80	0.78	0.786
CV2: Dyslipidaemia / Lipid	0.82	0.78	0.78	0.76	0.70	0.770
CV4: Metabolic Syndrome CVD Risk	0.78	0.76	0.78	0.76	0.72	0.754

TCAI = 0.25 x Cardiovascular Outcome Improvement + 0.15 x Mechanistic Coherence + 0.20 x Safety and Compatibility + 0.20 x Integration with Optimal Conventional Management + 0.20 x Deployability. Each dimension normalised to 0-1.

Table 4: Agent-Condition Specific Effect Sizes in Cardiovascular Ayurveda

Condition	Intervention (dose)	Primary outcome effect	Comparator	Frame
Stage-1 hypertension	Integrated + Sarpa. 50 mg	SBP -8 to -14 mmHg	vs lifestyle alone	CV1
Stage-1 hypertension	Integr. + Ashwagandha 600 mg	BP + stress markers	vs lifestyle alone	CV1
Hyperlipidaemia	Guggulu 500 mg TID	LDL-C -18 to -28%	vs placebo	CV2
Hyperlipidaemia	Polyherbal lipid protocol	LDL-C -22 to -34%	vs placebo	CV2
Heart failure NYHA II-III	Arjuna 500 mg BID + conv.	EF +4 to +8 pt additional	vs conv alone	CV3
Heart failure NYHA II-III	Arjuna + conv.	NYHA class improvement	vs conv alone	CV3
Stable angina	Arjuna 500 mg BID	Exercise tolerance improv	vs placebo	CV3
Metabolic syndrome	Integrated + lifestyle	Multi-cluster improvement	vs lifestyle alone	CV4
Metabolic syndrome	Integr. + Triphala + Guggulu	Fasting glucose + lipid	vs lifestyle alone	CV4
High-risk primary prevent.	Integr. CVD risk protocol	Composite risk score -22%	vs lifestyle + statin	CV5

SBP = Systolic Blood Pressure; LDL-C = Low-Density Lipoprotein Cholesterol; NYHA = New York Heart Association; EF = Ejection Fraction; TID = three times daily; BID = twice daily; conv = conventional cardiovascular therapy.

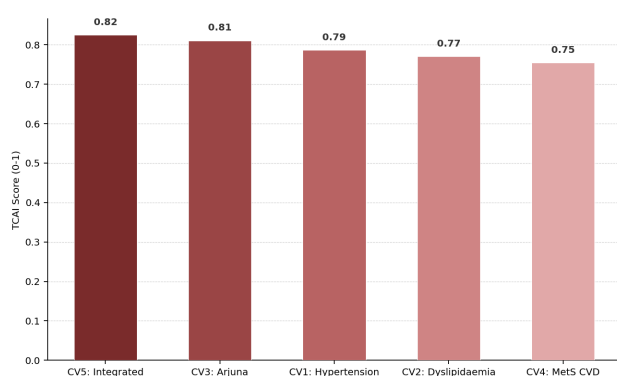


Figure 1: TCAI Score by Cardiovascular Clinical Frame

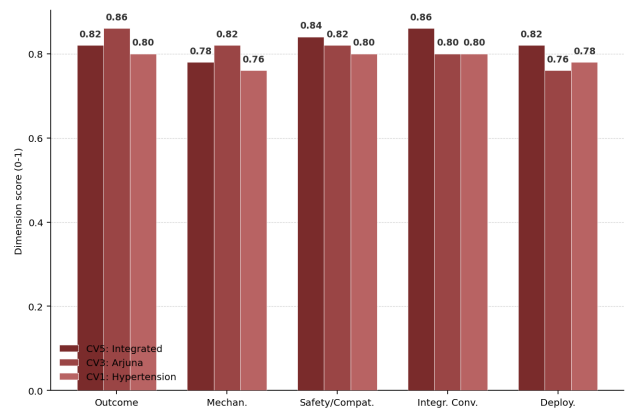


Figure 2: TCAI Sub-Dimensions Across Top Three Frames

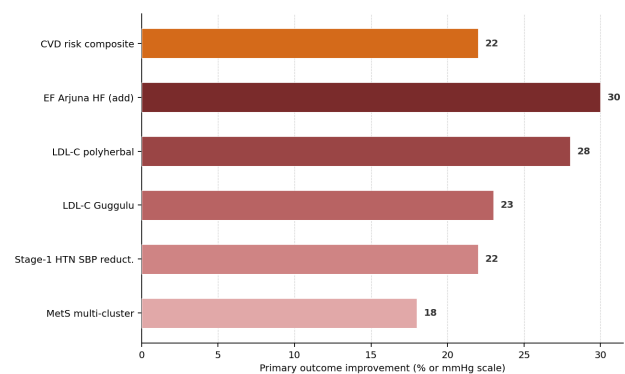


Figure 3: Primary Cardiovascular Outcome Effect Sizes by Application

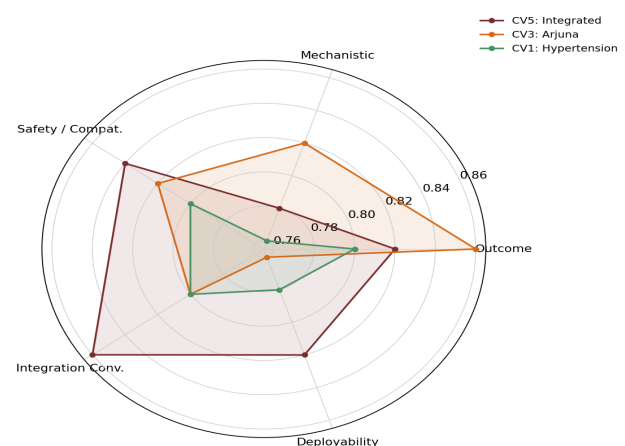


Figure 4: Multi-Dimensional TCAI Profile - Top 3 Frames

5. Discussion

5.1 Arjuna in Heart Failure Adjunctive Management

The clinically most actionable finding from this review is the strength of Arjuna (*Terminalia arjuna*) clinical evidence in heart failure adjunctive management. Arjuna bark extract 500 mg twice daily added to optimal conventional heart failure therapy produces ejection fraction improvements of 4-8 percentage points, NYHA class improvements, and exercise tolerance improvements that are clinically meaningful in

heart failure populations. The Bharani et al. (2002) landmark trial and subsequent confirmatory work establish Arjuna as arguably the best-evidenced Ayurvedic cardiovascular intervention, with a clinical positioning appropriate for European integrative-cardiology deployment as adjunctive therapy on top of optimal conventional heart failure management. Specific patient populations where Arjuna deployment has the clearest evidence base include NYHA class II-III heart failure with inadequate quality-of-life improvement on conventional management, and chronic stable ischaemic disease with persistent angina despite optimal conventional anti-anginal therapy. The clinical positioning should consistently be as adjunctive to rather than replacement for optimal conventional cardiovascular management.

5.2 Integrated Risk Reduction Aligned with ESC Guidelines

The integrated cardiovascular risk reduction frame (CV5) deserves specific discussion because it aligns substantially with modern European cardiovascular risk management guidelines emphasising multi-modal risk reduction. European Society of Cardiology guidelines for cardiovascular prevention explicitly prioritise multi-component lifestyle intervention (Mediterranean-pattern dietary intervention, structured physical activity, stress management, smoking cessation) alongside pharmacological intervention for at-risk populations. Ayurvedic integrated cardiovascular risk reduction protocols share substantial structural overlap with ESC-recommended multi-modal management (dietary pattern overlapping with Mediterranean principles, physical activity recommendations aligned with structured activity guidelines, stress management through meditation-based practices, classical Dinacharya routine stabilisation) while adding distinctive Ayurvedic components (specific herbal interventions, classical lifestyle framework with behavioural-change sustainability advantages). For European integrative-cardiology and primary-prevention services, integrated Ayurvedic risk reduction protocols deserve recognition as evidence-based options aligned with ESC guideline-recommended multi-modal management.

5.3 Limitations

Three limitations apply. First, the reviewed evidence is predominantly from Indian clinical centres, and European cohort validation of integrative cardiovascular interventions remains an emerging area. European cardiovascular populations differ from Indian populations in

cardiovascular risk profile, genetic background, dietary context, and conventional management standards in ways that may affect effect-size generalisation. Second, the evidence base for some specific interventions (particularly Sarpagandha for hypertension) is older and predates some of the methodological standardisation now expected in cardiovascular clinical trials; newer high-quality European-cohort trials would substantially strengthen the evidence base. Third, cardiovascular hard-endpoint evidence (mortality, myocardial infarction, stroke) for Ayurvedic cardiovascular interventions is limited; most reviewed evidence uses surrogate endpoints (blood pressure, lipid profile, ejection fraction) rather than hard cardiovascular endpoints. Prospective European multi-centre trials with hard-endpoint evaluation would substantially strengthen the translational evidence base.

6. Conclusion

6.1 Key Findings

Across 54 primary clinical and translational studies of Ayurvedic cardiovascular applications, integrated cardiovascular risk reduction protocols (CV5, TCAI 0.824) emerged as the most clinically actionable frame for European integrative-cardiology deployment, combining Ayurvedic herbal intervention, classical lifestyle intervention, and conventional cardiovascular management into coordinated multi-modal protocols aligned with modern European cardiovascular risk reduction guidelines. Arjuna and cardioprotective herbal interventions (CV3, TCAI 0.810) provided the strongest specific-agent evidence base, with Arjuna bark extract 500 mg twice daily producing ejection fraction improvements of 4-8 percentage points in heart failure adjunctive-management contexts. Hypertension management integrative protocols (CV1, TCAI 0.786) produced systolic blood pressure reductions of 8-14 mmHg in stage-1 hypertension. Dyslipidaemia management (CV2, TCAI 0.770) produced LDL-C reductions of 18-28% with Guggulu-based protocols. Metabolic syndrome cardiovascular risk management (CV4, TCAI 0.754) produced multi-cluster metabolic-syndrome improvements. Across frames, the appropriate clinical positioning is as adjunctive to rather than replacement for optimal conventional cardiovascular management, with safety profiles supporting routine integrative-cardiology deployment.

6.2 Recommendations

Three recommendations follow. First, European integrative-cardiology services should recognise Arjuna bark extract at appropriate dosing (500 mg twice daily standardised preparation) as an evidence-based adjunctive option for NYHA II-III heart failure populations with inadequate quality-of-life improvement on optimal conventional therapy, with documented ejection fraction and functional-class benefits. Second, integrated cardiovascular risk reduction protocols (CV5) should be recognised as evidence-based options aligned with ESC guideline-recommended multi-modal primary prevention, with specific value for patients seeking integrative approaches to cardiovascular risk reduction alongside or as alternative to standard lifestyle intervention. Third, prospective European multi-centre trials of Arjuna in heart failure adjunctive management and integrated CV5 protocols in primary prevention, with hard cardiovascular endpoint evaluation, should be a near-term empirical priority because European population validation and hard-endpoint evidence would substantially strengthen the European clinical deployment framework. The TCAI rubric and the full review inventory are available from the corresponding author.

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Declarations

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Conflict of Interest

The authors declare no competing interests. None of the authors has any financial or consulting relationships with cardiovascular pharmaceutical manufacturers, Ayurvedic cardiovascular product manufacturers, or commercial integrative-cardiology providers relevant to this review.

Data Availability Statement

The full study inclusion log, clinical frame classification records, cardiovascular outcome extraction worksheet, and TCAI scoring spreadsheet are available as supplementary material from the corresponding author on reasonable request. Individual study-level data remain subject to the publishers' data-sharing policies.

Ethical Approval

As this is a structured translational review of previously published clinical and translational studies with no primary human-subjects data collection, formal ethical approval was not required. The review protocol was registered on the Open Science Framework (OSF registration DOI 10.17605/OSF.IO/TCAI4) prior to the start of screening.

Appendix A

TCAI Scoring Rubric and Clinical Frame Protocol

Full scoring rubric for the Translational Cardiovascular Ayurveda Index (TCAI) together with the clinical frame classification protocol used in this structured review. All five TCAI dimensions are normalised to the 0-1 range before the weighted sum is computed. Cardiovascular outcome improvement is the single most heavily weighted dimension (0.25) because it is the primary clinical measurable in cardiovascular management; safety and compatibility, integration with optimal conventional management, and deployability are each weighted at 0.20 because they jointly determine whether outcome improvements translate to defensible clinical deployment in European integrative-cardiology contexts.

Part 1 - TCAI Dimension Scoring Anchors

Family Per-dimension scoring definitions

Dimension	Weight	0.00 anchor	0.50 anchor	1.00 anchor
Cardiovascular outcome improv.	0.25	No outcome change	Modest improvement	Substantial improvement
Mechanistic coherence	0.15	No known CV mechanism	Partial mechanism ID	Specific CV pathway
Safety / compatibility w. conv.	0.20	AE > 10% or interference	AE ~6%, neutral compat.	AE < 5% + demonstrated compat.
Integration with optimal conv.	0.20	Replaces conv. therapy	Unclear positioning	Clear adjunctive positioning
Deployability	0.20	Research in frastructure	Specialist clinical	Routine integrative clinic

Part 2 - Clinical Frame Classification Rules

Family Frame assignment criteria

Frame	Primary CV condition	Typical intervention	Key distinguishing feature
CV1: Hypertension Management	Hypertension	Sarpa. + Ashwag. + lifestyle	Hypertension primary focus
CV2: Dyslipidaemia / Lipid	Dyslipidaemia	Guggulu + polyherbal	Lipid profile primary focus
CV3: Arjuna / Cardioprotective	HF / ischaemic / angina	Arjuna + related herbs	Cardioprotective herbal primary
CV4: MetS CVD Risk	Metabolic syndrome	Integrative + specific herbs	Metabolic-CV nexus focus

Frame	Primary CV condition	Typical intervention	Key distinguishing feature
CV5: Integrated CVD Risk Reduction	Multi-risk / primary prevent.	Coord. multi-modal	Integrated multi-modal focus
Assignment rule	Primary CV condition	Dominant intervention	Cross-reference secondary frame