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ORIGINAL

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Traditional and infusion-based yerba mate consumption and lipid profile in adults: a systematic review and meta-analysis

Consumo tradicional y en infusión de yerba mate y perfil lipídico en adultos: revisión sistemática y metaanálisis

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ABSTRACT

Introduction: Yerba mate (Ilex paraguariensis) is widely consumed in South America in infusions and contains compounds that may influence cardiometabolic pathways. However, evidence on its effects on lipid profile remains heterogeneous. **Objective:** To synthesize evidence on traditional yerba mate consumption and lipid profile in adults, focusing on total cholesterol, LDL-C, HDL-C, and triglycerides. **Methodology:** A systematic review and meta-analysis was conducted across multiple databases. Human studies in adults assessing yerba mate exposure and lipid-profile outcomes were eligible. Randomized, non-randomized, pre-post, and observational studies were included for qualitative synthesis. Random-effects meta-analyses were based on mean differences in mg/dL. A primary controlled analysis compared yerba mate with control comparators, and a secondary pre-post analysis estimated within-group changes in yerba mate-exposed arms. **Results:** Database searches identified 173 records. Nine studies were included in the qualitative synthesis; seven contributed to quantitative synthesis. In the primary controlled meta-analysis, yerba mate was not associated with significant changes in total cholesterol (MD 0.49 mg/dL; 95% CI -7.00 to 7.98), LDL-C (MD 0.74 mg/dL; 95% CI -6.10 to 7.58), HDL-C (MD -0.00 mg/dL; 95% CI -1.83 to 1.82), or triglycerides (MD 1.77 mg/dL; 95% CI -2.86 to 6.40). In the secondary pre-post analysis, yerba mate-exposed arms showed reductions in total cholesterol (-11.02 mg/dL), LDL-C (-10.90 mg/dL), and triglycerides (-6.18 mg/dL), with a small decrease in HDL-C (-1.26 mg/dL). **Conclusion:** Controlled evidence did not confirm significant lipid changes from yerba mate compared with comparators. Pre-post analyses suggested a lipid-lowering effect, particularly for total cholesterol and LDL-C, but causal interpretation is limited by study design and bias. Better powered randomized controlled trials using standardized preparations are needed.

KEYWORDS Yerba mate · Cholesterol · Cholesterol, LDL · Cholesterol, HDL · Triglycerides · Lipids · Systematic review · Meta-analysis

RESUMEN

Introducción: La yerba mate (Ilex paraguariensis) es popular en América del Sur y contiene compuestos que pueden afectar las vías cardiometabólicas. La evidencia sobre sus efectos en el perfil lipídico es variable, especialmente entre el consumo tradicional y los extractos solubles. **Objetivo:** Sintetizar la evidencia sobre el consumo de yerba mate y el perfil lipídico en adultos. **Metodología:** Se realizó una revisión sistemática y metaanálisis en múltiples bases de datos. Se incluyeron estudios en adultos que evaluaron la exposición a la yerba mate y resultados del perfil lipídico. Se conservaron para la síntesis cualitativa y cuantitativa estudios aleatorizados y no aleatorizados. Los metaanálisis de efectos aleatorios utilizaron diferencias de medias en mg/dL. Un análisis primario comparó la yerba mate con controles, y un análisis pre-post secundario estimó cambios intragrupo. **Resultados:** De 173 registros, nueve estudios se incluyeron en la síntesis cualitativa y siete en la cuantitativa. El metaanálisis primario no encontró cambios significativos en colesterol total (DM 0,49 mg/dL, IC 95 % -7,00 a 7,98), LDL-C (DM 0,74 mg/dL, IC 95 % -6,10 a 7,58), HDL-C (DM -0,00 mg/dL, IC 95 % -1,83 a 1,82) ni triglicéridos (DM 1,77 mg/dL, IC 95 % -2,86 a 6,40). En el análisis secundario, la yerba mate mostró reducciones en colesterol total (-11,02 mg/dL), LDL-C (-10,90 mg/dL) y triglicéridos (-6,18 mg/dL), y una leve disminución del HDL-C (-1,26 mg/dL). **Conclusión:** La evidencia controlada no mostró cambios lipídicos significativos atribuibles a la yerba mate. Los análisis intragrupo sugirieron un posible efecto hipolipemiante, pero la causalidad está limitada por el diseño, la heterogeneidad y el riesgo de sesgo. Se requieren ensayos controlados aleatorizados más robustos.

PALABRAS CLAVE Yerba mate · Colesterol · LDL-Colesterol · HDL-Colesterol · Triglicéridos · Lípidos · Revisión sistemática · Metaanálisis

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Introduction

Cardiovascular diseases remain the leading cause of death worldwide, accounting for a large share of global mortality and premature deaths, particularly in low- and middle-income countries (1). Dyslipidemia is one of the major modifiable determinants of atherosclerotic cardiovascular disease, and convergent genetic, epidemiological and trial evidence supports a causal role of LDL-C in atherogenesis (2). Accordingly, contemporary dyslipidemia guidelines emphasize LDL-C reduction as a central therapeutic target while recognizing lifestyle and dietary strategies as essential components of cardiovascular prevention (3).

Yerba mate, prepared from the leaves of Ilex paraguariensis A. St.-Hil., is traditionally consumed in several South American countries as hot mate or chimarrão, cold tereré, and other infusion-based preparations. Beyond its cultural role, yerba mate contains phenolic acids, methylxanthines, flavonoids, saponins and other bioactive constituents with antioxidant, anti-inflammatory and metabolic properties (4,5). This phytochemical profile has made yerba mate a candidate dietary exposure for cardiometabolic research.

Experimental and translational evidence suggests several plausible mechanisms through which yerba mate may influence lipid metabolism, including modulation of oxidative stress, LDL oxidation, bile acid metabolism, intestinal lipid absorption, inflammation and hepatic lipid handling (4,5). Nevertheless, human evidence remains difficult to interpret because studies have differed substantially in population, preparation type, dose, volume, intervention duration, comparator and risk of bias. These differences are especially relevant because traditional high-volume infusions may not be biologically or behaviorally equivalent to capsules, extracts or low-dose soluble preparations.

Previous systematic reviews have addressed this question only partially. Clemente et al. synthesized placebo-controlled trials available up to 2020 and focused on randomized evidence comparing *Ilex paraguariensis* with placebo (6). Masson et al. subsequently published a systematic review and meta-analysis including 13 studies and reported no statistically significant effects of yerba mate on total cholesterol, LDL-C, HDL-C or triglycerides (7). More recently, Li et al. evaluated yerba mate in relation to glycemic control and metabolic health, with lipid outcomes considered as secondary endpoints (8). However, these reviews did not systematically separate controlled evidence from uncontrolled within-group changes, nor did they specifically distinguish traditional high-volume hot or cold preparations from low-dose soluble or less comparable formulations. The present review therefore updates the evidence and addresses these methodological gaps.

Therefore, this systematic review and meta-analysis aimed to evaluate the association between traditional or infusion-based yerba mate consumption and lipid profile in adults, focusing on total cholesterol, LDL-C, HDL-C and triglycerides.

Methodology

Design and reporting

This systematic review and meta-analysis was conducted according to PRISMA 2020 recommendations (9). The protocol was registered with CRD42024575215. The review question was structured to evaluate whether traditional or infusion-based yerba mate consumption is associated with changes in lipid profile among adults.

Eligibility criteria

Eligible studies included adults exposed to yerba mate or Ilex paraguariensis preparations consumed as traditional beverages, infusions, mate tea, chimarrão, tereré, cocido or closely related drinkable preparations. Using a PICO framework, the population was adults, the exposure/intervention was yerba mate consumed as traditional hot or cold preparations or related drinkable infusions, the comparators were placebo, control beverages, active dietary comparators or baseline values, and the outcomes were total cholesterol, LDL-C, HDL-C and triglycerides.

Randomized controlled trials, crossover trials, non-randomized intervention studies, pre-post studies and observational studies were considered for qualitative synthesis when they reported lipid-profile outcomes. Eligible outcomes were total cholesterol, LDL-C, HDL-C, triglycerides or related lipid parameters. Studies were excluded if they were conducted exclusively in animals, in vitro or cell models; did not report eligible lipid-profile outcomes; evaluated multi-ingredient supplements in which the independent effect of yerba mate could not be isolated; or were conference abstracts, protocols or registry records without complete results when a full article was unavailable or superseded the record.

Information sources and search strategy

Searches were conducted on May 5, 2026 in PubMed/MEDLINE, Scopus, Web of Science, BVS/LILACS and Cochrane CENTRAL. The search strategy combined terms for Ilex paraguariensis and yerba mate preparations, including yerba mate, mate tea, chimarrão, chimarrao, tereré and terere, with lipid-related terms such as cholesterol, LDL, HDL, triglycerides, lipids, lipoproteins and lipid profile. Animal and in vitro terms were excluded where database syntax permitted. No additional restrictions were applied by language at the search stage.

Study selection

Records identified from the databases were deduplicated before screening. Titles and abstracts were screened for relevance, followed by full-text assessment of potentially eligible reports. Reasons for full-text exclusion were recorded and grouped as absence of eligible lipid outcomes, incomplete or superseded report, or registry/protocol record corresponding to a later published study. The final selection distinguished studies included in qualitative synthesis, studies included in at least one quantitative synthesis, and observational studies retained for narrative synthesis only. These stages were carried out independently by two reviewers (JM and MF). Discrepancies were resolved by consensus or, if necessary, with the participation of a third reviewer (JP).

Data extraction

Data were extracted on author, year, country, design, population, sample size, intervention or exposure, comparator, duration, lipid outcomes, means, dispersion measures and analytic role. These stages were carried out independently by two reviewers (MC and CR). Discrepancies were resolved by consensus or, if necessary, with the participation of a third reviewer (JP). When outcomes were reported as standard errors of the mean, these were handled according to the reported dispersion type. For controlled analyses, effect estimates were calculated as yerba mate minus comparator. For pre-post analyses, change was calculated as final or condition value minus baseline value.

Risk-of-bias assessment

Risk of bias was assessed independently by two reviewers (GG and GV), based on the design of each study. Randomized controlled trials were assessed using the RoB 2 tool, incorporating specific considerations for crossover designs where appropriate (10). Non-randomized, quasi-experimental pre-post, and observational studies were assessed using ROBINS-I (11). Any discrepancies between reviewers were resolved by consensus. Risk of bias

assessments guided the interpretation of findings, the eligibility of studies for the primary or secondary synthesis, and sensitivity analyses. Observational studies were included only in the narrative synthesis and were not combined with intervention studies.

Data synthesis and statistical analysis

Mean differences in mg/dL were used as the effect measure because lipid outcomes were reported on the same scale across studies. The primary quantitative synthesis was a controlled random-effects meta-analysis comparing yerba mate with control or active comparator groups. Negative values favored yerba mate for total cholesterol, LDL-C and triglycerides, whereas positive values favored yerba mate for HDL-C. A secondary pre-post meta-analysis estimated within-group changes among yerba mate-exposed arms; this analysis was considered supportive rather than causal because several contributing studies lacked external controls and some standard errors of change were approximated from available baseline and final dispersion measures.

Random-effects models were fitted using restricted maximum likelihood estimation with Knapp-Hartung adjustment because of the small number of comparisons per outcome. Heterogeneity was evaluated using tau-squared, Cochran Q and I-squared. Sensitivity analyses excluded the low-dose soluble mate study and, separately, studies using active dietary comparators in the controlled analysis. Additional pre-post sensitivity analyses excluded the low-dose soluble mate study and restricted the dataset to traditional or high-volume yerba mate exposure. Analyses were conducted in R using the metafor package (12). Funnel plots, Egger tests and meta-regression were not conducted because the number of studies per analysis was small and such analyses would be underpowered and potentially misleading.

When standard errors of change were not reported, they were approximated from available baseline and final dispersion measures. In the absence of reported within-person correlations, the variance of change was approximated conservatively without assuming a positive baseline-follow-up correlation. Therefore, secondary pre-post analyses were interpreted as supportive and were not used as the primary basis for causal inference.

Results

The results are presented in four parts: study selection, characteristics of the included studies, risk-of-bias assessment, and quantitative synthesis. Quantitative findings are organized into a primary controlled meta-analysis and a secondary pre-post analysis. The controlled analysis was prioritized for causal interpretation, whereas the pre-post analysis was interpreted as supportive evidence.

Study selection

Database searching identified 173 records: seven from PubMed/MEDLINE, 71 from Scopus, 61 from Web of Science, eight from BVS/LILACS and 26 from Cochrane CENTRAL. After removal of 54 duplicates, 119 records were screened by title and abstract, of which 102 were excluded. Seventeen reports were sought and retrieved for full-text assessment. Eight full-text reports were excluded: four because they did not report eligible lipid-profile outcomes, three because they were conference abstracts or registry/protocol records superseded by a full article or lacking complete results, and one because it corresponded to a later published study. Nine studies were included in the qualitative/narrative synthesis. Seven studies contributed data to at least one quantitative synthesis: five to the primary controlled meta-analysis and seven to the secondary pre-post meta-analysis. Two observational studies were retained for narrative synthesis only (Figure 1).

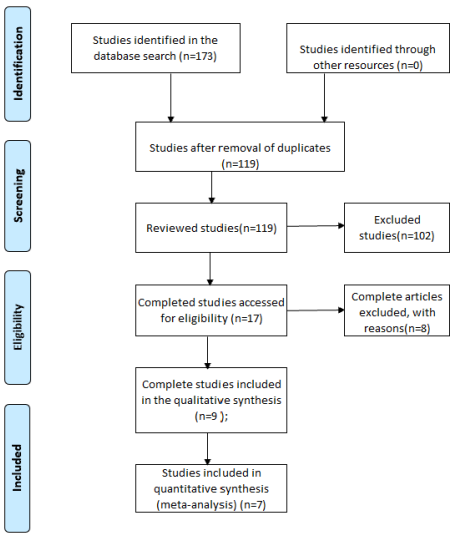

FIGURE 1
Study selection flow.

Characteristics of included studies

The included studies covered different yerba mate preparations, populations and study designs (Table 1). Most interventional studies evaluated mate tea or traditional mate preparations over periods ranging from 15 days to 12 weeks. Observational evidence came mainly from habitual consumption of tereré, mate, cocido or chimarrão in South American populations. Because of this methodological diversity, controlled and pre-post evidence were synthesized separately.

TABLE 1. CHARACTERISTICS OF INCLUDED STUDIES.

Study	Country	Design	Population	Sample_size	Exposure_or_intervention	Comparator	Duration	Role_in_synthesis
de Morais et al., 2009	Brazil	Single-blind controlled pre-post intervention	Normolipidemic, dyslipidemic and statin-treated hypercholesterolemic adults	102	Yerba mate infusion, approximately 1 L/day, 40 days	Baseline period; no external non-mate control	40 days	Narrative and secondary pre-post synthesis
Klein et al., 2011	Brazil	Randomized controlled pilot intervention	Adults with type 2 diabetes or prediabetes	58 completers	Roasted mate tea, 330 mL three times/day	Dietary intervention or mate plus dietary intervention arms	60 days	Primary controlled and secondary pre-post synthesis
Boaventura et al., 2012	Brazil	Randomized clinical trial	Dyslipidemic adults	74	Mate tea, approximately 1 L/day	Dietary intervention or mate plus dietary intervention	90 days	Primary controlled and secondary pre-post synthesis
Messina et al., 2015	Argentina	Longitudinal experimental pre-post study	Dyslipidemic adults without lipid-lowering treatment	121	Traditional mate, 50 g/day or 100 g/day	No external non-mate control	12 weeks	Narrative and secondary pre-post synthesis
Souza et al., 2017	Brazil	Randomized double-blind placebo-controlled crossover trial	Adults with HIV/AIDS receiving antiretroviral therapy	92 completers	Soluble mate tea, 3 g/day	Placebo mate	15 days per phase	Primary controlled and sensitivity analyses; low-dose nontraditional exposure
Chaves et al., 2018	Paraguay	Observational real-world habitual intake study	Adults from a large cardiometabolic risk cohort	18,287	Habitual intake of tereré, mate and/or cocido	Comparison by intake volume	Cross-sectional/habitual exposure assessment	Narrative synthesis only
da Veiga et al., 2018	Brazil	Post hoc observational analysis	Postmenopausal women	95	Habitual chimarrão/mate intake	Comparison by intake volume	Post hoc exposure assessment	Narrative synthesis only
Avena et al., 2019	Argentina	Longitudinal experimental study with group allocation	Overweight women	119	Yerba mate, 100 g/day prepared with 2 L water; mate with or without diet	Water plus hypocaloric diet	12 weeks	Primary controlled and secondary pre-post synthesis
Bravo et al., 2025	Spain	Randomized controlled blinded crossover trial	Normocholesterolemic and hypercholesterolemic nonhabitual consumers	52	Yerba mate tea, 9 g leaves/day, three servings/day	Control drink	8 weeks per intervention period	Primary controlled and secondary pre-post synthesis

Risk of bias

Risk of bias varied according to study design (Table 2). Outcome measurement was generally judged to be at low risk because lipid parameters were laboratory-based. However, randomized and crossover studies frequently had some concerns related to incomplete reporting of allocation procedures, active dietary comparators, missing data or lack of paired variance for crossover analyses. Non-randomized and observational studies were generally judged at serious risk of bias, mainly because of confounding, absence of external non-mate controls or post hoc exposure classification.

TABLE 2. SUMMARY RISK-OF-BIAS ASSESSMENT.

Study	Design category	Tool used	Overall risk of bias	Main concerns	Implication for synthesis
de Morais et al., 2009	Pre-post intervention without external non-mate control	ROBINS-I	Serious	Absence of external control group; possible regression to the mean; baseline-final comparison; statin subgroup includes pharmacological cointervention	Narrative and secondary pre-post synthesis; not primary controlled meta-analysis
Klein et al., 2011	Randomized controlled pilot intervention	RoB 2	Some concerns	Limited allocation reporting; small sample per arm; active dietary comparator; dietary changes during follow-up	Controlled synthesis with caution; sensitivity analysis recommended
Boaventura et al., 2012	Randomized clinical trial	RoB 2	Some concerns	Limited randomization details; active dietary comparator; lipid outcomes secondary	Controlled and pre-post synthesis; cautious interpretation
Messina et al., 2015	Longitudinal experimental pre-post study	ROBINS-I	Serious	No external non-mate control; baseline-final comparison; possible time/diet/adherence/regression effects	Narrative and secondary pre-post synthesis due to traditional mate relevance
Souza et al., 2017	Randomized double-blind placebo-controlled crossover trial	RoB 2, crossover considerations	Some concerns to high	Substantial attrition; paired variance not reported; low-dose short-duration soluble mate exposure	Controlled synthesis/sensitivity; nontraditional low-dose exposure
Chaves et al., 2018	Observational real-world habitual intake study	ROBINS-I	Serious	Confounding by diet, sex, body weight, lifestyle and cardiometabolic profile; self-reported exposure	Narrative only; not pooled
da Veiga et al., 2018	Post hoc observational analysis	ROBINS-I	Serious	Post hoc exposure classification; small high-intake group; residual confounding; partly self-reported diagnoses	Narrative only; contextual evidence
Avena et al., 2019	Longitudinal experimental study with randomized group allocation	RoB 2, with caution	Some concerns to high	Group-specific denominators not reported in article; n per arm obtained by author correspondence; diet cointervention	Controlled and pre-post synthesis; sensitivity analysis recommended
Bravo et al., 2025	Randomized controlled crossover trial	RoB 2, crossover considerations	Some concerns	Paired variance not reported; period/carryover considerations; control drink produced lipid changes in hypercholesterolemic subgroup	Key updated controlled evidence; subgroup interpretation required

Quantitative synthesis

The primary controlled dataset included seven comparisons per lipid outcome. The secondary pre-post dataset included 12 yerba mate-exposed arms per outcome. Mean differences were expressed in mg/dL (Table 3).

TABLE 3. SUMMARY OF META-ANALYSIS RESULTS FOR YERBA MATE INTAKE AND LIPID PROFILE.

Analysis	Outcome	Comparisons / arms (k)	MD or mean change, mg/dL (95% CI)	p value	I^2	Interpretation
Primary controlled analysis	Total cholesterol	7	0.49 (-7.00 to 7.98)	0.878	18.4%	No statistically significant difference
Primary controlled analysis	LDL-C	7	0.74 (-6.10 to 7.58)	0.800	20.5%	No statistically significant difference
Primary controlled analysis	HDL-C	7	-0.00 (-1.83 to 1.82)	0.996	8.1%	No statistically significant difference
Primary controlled analysis	Triglycerides	7	1.77 (-2.86 to 6.40)	0.386	0.0%	No statistically significant difference
Secondary pre-post analysis	Total cholesterol	12	-11.02 (-16.76 to -5.29)	0.001	47.2%	Within-group reduction
Secondary pre-post analysis	LDL-C	12	-10.90 (-15.30 to -6.50)	<0.001	40.0%	Within-group reduction
Secondary pre-post analysis	HDL-C	12	-1.26 (-1.89 to -0.62)	0.001	0.0%	Within-group decrease
Secondary pre-post analysis	Triglycerides	12	-6.18 (-9.53 to -2.83)	0.002	0.0%	Within-group reduction

In the primary controlled analysis, effects were calculated as yerba mate minus control/comparator. Therefore, negative values favor yerba mate for total cholesterol, LDL-C and triglycerides, whereas positive values favor yerba mate for HDL-C. The secondary pre-post analysis represents within-group change from baseline among yerba mate-exposed arms.

Primary controlled meta-analysis

In the primary controlled meta-analysis, yerba mate intake was not associated with statistically significant differences in total cholesterol, LDL-C, HDL-C or triglycerides compared with control or active comparator groups (Figure 2). The pooled mean difference was 0.49 mg/dL for total cholesterol (95% CI: -7.00 to 7.98; p = 0.878; I^2 = 18.4%), 0.74 mg/dL for LDL-C (95% CI: -6.10 to 7.58; p = 0.800; I^2 = 20.5%), -0.00 mg/dL for HDL-C (95% CI: -1.83 to 1.82; p = 0.996; I^2 = 8.1%), and 1.77 mg/dL for triglycerides (95% CI: -2.86 to 6.40; p = 0.386; I^2 = 0.0%).

Sensitivity analyses did not materially alter the primary findings. Exclusion of the low-dose soluble mate study produced similar estimates across lipid outcomes. When studies using active dietary comparators were excluded, the direction of effect shifted toward lower total cholesterol and LDL-C and higher HDL-C, but estimates remained statistically non-significant and were based on only three comparisons per outcome.

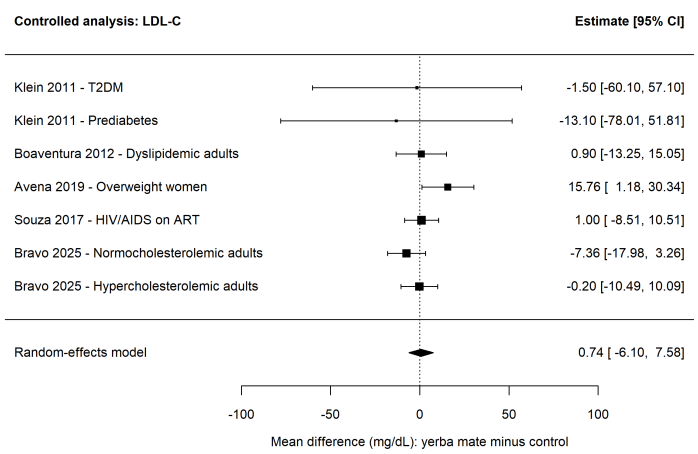

FIGURE 2
Forest plot of the primary controlled meta-analysis for LDL-C. Mean differences are expressed as yerba mate minus control/comparator. Negative values favor yerba mate.

Secondary pre-post analysis

In the secondary pre-post analysis, yerba mate-exposed arms showed significant within-group reductions in total cholesterol, LDL-C and triglycerides. The pooled mean change was -11.02 mg/dL for total cholesterol (95% CI: -16.76 to -5.29; p = 0.001; I^2 = 47.2%), -10.90 mg/dL for LDL-C (95% CI: -15.30 to -6.50; p < 0.001; I^2 = 40.0%), and -6.18 mg/dL for triglycerides (95% CI: -9.53 to -2.83; p = 0.002; I^2 = 0.0%). HDL-C also decreased slightly, with a pooled mean change of -1.26 mg/dL (95% CI: -1.89 to -0.62; p = 0.001; I^2 = 0.0%).

Exclusion of the low-dose soluble mate study did not attenuate the pre-post findings. Instead, reductions in total cholesterol and LDL-C became numerically larger, and heterogeneity decreased, particularly for LDL-C.

Traditional or high-volume yerba mate exposure

In the traditional/high-volume pre-post sensitivity analysis, reductions remained statistically significant for total cholesterol, LDL-C and triglycerides (Figure 3). The pooled mean change was -13.97 mg/dL for total cholesterol, -14.91 mg/dL for LDL-C, -1.36 mg/dL for HDL-C and -6.36 mg/dL for triglycerides. These findings support a within-group lipid-lowering signal for traditional yerba mate consumption, although causal interpretation remains limited by the absence of external non-mate control groups in several contributing studies.

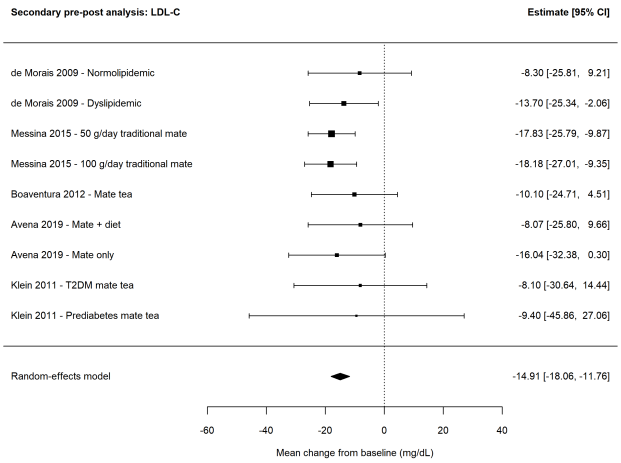

FIGURE 3
Forest plot of the traditional/high-volume pre-post sensitivity analysis for LDL-C. Values represent mean change from baseline. Negative values indicate reductions in LDL-C.

Summary of quantitative findings

Overall, the controlled evidence did not demonstrate statistically significant lipid changes attributable to yerba mate compared with control or active comparator groups. In contrast, secondary pre-post analyses showed consistent within-group reductions in total cholesterol, LDL-C and triglycerides, particularly in analyses restricted to traditional or high-volume yerba mate exposure. These findings suggest a possible lipid-lowering signal, but causal interpretation should remain cautious because the most favorable estimates came from within-group analyses rather than controlled comparisons.

Discussion

This systematic review and meta-analysis provides an updated synthesis of traditional or infusion-based yerba mate consumption and lipid profile in adults. The main finding is intentionally two-layered. In the primary controlled analysis, yerba mate did not produce statistically significant differences in total cholesterol, LDL-C, HDL-C or triglycerides compared with control or active comparator groups. In contrast, the secondary pre-post analysis showed consistent within-group reductions in total cholesterol, LDL-C and triglycerides, particularly when restricted to traditional or high-volume consumption. This pattern suggests a plausible lipid-lowering signal, but one that is more visible in within-group change than in controlled comparisons.

The distinction between controlled and pre-post evidence is central to interpretation. Controlled analyses are better suited to causal inference because they account, at least partially, for temporal changes, regression to the mean and cointerventions. In this review, the controlled meta-analysis included heterogeneous comparators: active dietary interventions in some trials and placebo or control beverages in others. The absence of statistically significant pooled effects therefore does not necessarily rule out a biological effect of yerba mate; rather, it indicates that the available controlled evidence is not yet sufficiently precise or internally consistent to confirm a lipid-lowering effect beyond comparator effects.

The pre-post findings were more favorable. Reductions in total cholesterol and LDL-C were observed across several intervention arms, including traditional or high-volume preparations. These results are consistent with the direction reported in early intervention studies in dyslipidemic adults and statin-treated individuals (13), in patients with diabetes or prediabetes (14), and in dyslipidemic adults receiving mate tea (15,16). The traditional/high-volume sensitivity analysis strengthened the magnitude of total cholesterol and LDL-C reductions, suggesting that exposure pattern may matter. Traditional preparations usually involve higher volume, repeated servings and prolonged contact with the plant matrix, which could differ meaningfully from low-dose soluble mate exposure.

Nevertheless, several features caution against overinterpretation. de Morais et al. and Messina et al. provided clinically relevant intervention evidence, but both relied on baseline-final comparisons without an external non-mate control group (13,16). Avena et al. included a dietary comparator and showed lipid improvements across groups, making it difficult to isolate the independent contribution of mate from hypocaloric diet or lifestyle changes (17). Boaventura et al. reported LDL-C improvement in the mate arm, but lipid outcomes were not the sole primary focus and comparator arms involved dietary intervention (15). Thus, the most favorable estimates in the present synthesis should be read as supportive signals rather than definitive causal effects.

The crossover trials add a different perspective. Souza et al. evaluated a low-dose soluble mate preparation among adults with HIV/AIDS receiving antiretroviral therapy and did not show meaningful lipid changes (18). Bravo et al., a recent randomized controlled crossover trial in nonhabitual consumers, provided more contemporary controlled evidence and suggested cardiometabolic effects in some strata, but control beverage responses and the absence of paired variance for lipid outcomes limited quantitative precision (19). These trials reinforce the need to distinguish traditional mate exposure from soluble low-dose preparations and to interpret crossover results with attention to period, carryover and within-person variance.

The observational studies contributed important contextual evidence but were not pooled with intervention studies. Chaves et al. provided a large Paraguayan real-world analysis of habitual consumption of tereré, mate and cocido, while da Veiga et al. evaluated habitual chimarrão or mate intake in postmenopausal women (20,21). These studies are highly relevant to regional consumption patterns and external validity, but their exposure classification, residual confounding and lack of randomized allocation limit causal inference. Their main contribution is therefore hypothesis generation and contextualization rather than estimation of intervention effects.

The small but statistically significant HDL-C decrease observed in the pre-post analysis deserves attention. Unlike LDL-C and total cholesterol reductions, a decrease in HDL-C is not conventionally interpreted as favorable. However, the magnitude was small, heterogeneity was negligible, and HDL-C concentration alone does not fully capture HDL function or reverse cholesterol transport. Because several contributing studies involved dietary changes, weight change, metabolic disease or uncontrolled pre-post designs, this finding should be interpreted cautiously and should not be considered evidence of harm without corroborating functional or clinical outcomes.

Biological plausibility remains credible. Yerba mate contains chlorogenic acids and related polyphenols, methylxanthines and saponins that may influence oxidative stress, inflammation, lipid absorption and lipoprotein metabolism (4,5). The observed within-group reductions in total cholesterol and LDL-C are compatible with these mechanisms, but the controlled evidence indicates that future studies must isolate yerba mate effects from dietary advice, caloric restriction, background lifestyle change and regression to the mean. Standardization of dose, preparation temperature, leaf mass, infusion volume, duration and comparator composition will be essential.

This review has strengths. It focused specifically on adult lipid-profile outcomes and separated controlled evidence from secondary pre-post evidence, avoiding a single pooled estimate that would obscure design differences. It also prioritized traditional or infusion-based exposure, incorporated a recent controlled trial, and retained observational South American evidence for narrative interpretation without pooling it inappropriately. Risk of bias was assessed using design-specific tools, and sensitivity analyses explored the influence of low-dose soluble mate and active dietary comparators.

Limitations should also be acknowledged. The number of controlled studies was small, and several comparisons had small samples, active comparators or incomplete reporting of allocation and paired variance. Some pre-post standard errors were approximated from available dispersion measures because change variance was not consistently reported. Observational studies were vulnerable to residual confounding and self-reported exposure. Publication bias could not be reliably assessed because the number of studies per outcome was below conventional thresholds for funnel-plot or regression-based methods. Finally, the clinical relevance of modest lipid changes should be interpreted in light of baseline risk, intervention duration and sustainability of traditional consumption patterns.

In adults, current controlled evidence does not confirm statistically significant lipid-profile changes attributable to yerba mate compared with control or active comparator groups. Secondary pre-post analyses suggest consistent within-group reductions in total cholesterol, LDL-C and triglycerides, especially for traditional or high-volume yerba mate exposure, but these findings should be considered supportive rather than causal. Future adequately powered randomized controlled trials should evaluate standardized traditional preparations, use appropriate placebo or control beverages, report paired change variance, and stratify by baseline lipid status and habitual consumption.

Editorial note

The opinions expressed in this article, as well as the methodological approach and results presented, are the sole responsibility of the authors. This work was reviewed and approved by external reviewers as part of the editorial process, but does not necessarily reflect the official position of the journal, its editorial committee, or its editor-in-chief.

Data availability

Data are available upon request to the corresponding author. Guiomar Viveros. Email: investigacion@fcs.unca.edu.py

Reviewer Comments

The comments and recommendations issued during the peer review process are available at the following link: Dictamen 732

References

1. World Health Organization. Cardiovascular diseases (CVDs). Geneva: WHO. 2025. URL
2. Ference BA, Ginsberg HN, Graham I, Ray KK, Packard CJ, Bruckert E, et al. Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European Atherosclerosis Society Consensus Panel. Eur Heart J. 2017;38(32):2459-2472. https://doi.org/10.1093/eurheartj/ehx144
3. Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, et al. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. Eur Heart J. 2020;41(1):111-188. https://doi.org/10.1093/eurheartj/ehz455
4. Heck CI, de Mejia EG. Yerba mate tea (Ilex paraguariensis): a comprehensive review on chemistry, health implications, and technological considerations. J Food Sci. 2007;72(9):R138-R151. https://doi.org/10.1111/j.1750-3841.2007.00535.x
5. Bracesco N, Sanchez AG, Contreras V, Menini T, Gugliucci A. Recent advances on Ilex paraguariensis research: minireview. J Ethnopharmacol. 2011;136(3):378-384. https://doi.org/10.1016/j.jep.2010.06.032
6. Clemente M, Wiens A, Miguel MD, Felipe KB, Clemente EF, Gribner C, et al. Efficacy of Ilex paraguariensis versus placebo on lipid profile in randomized clinical trial: a systematic review and meta-analysis. Pharmacogn Rev. 2020;14(28):91-96. https://doi.org/10.5530/phrev.2020.14.13
7. Masson W, Barbagelata L, Lobo M, Nogueira JP, Corral P, Lavalle-Cobo A. Effect of yerba mate (Ilex paraguariensis) on lipid levels: a systematic review and meta-analysis. Plant Foods Hum Nutr. 2022;77(3):353-366. https://doi.org/10.1007/s11130-022-00991-2
8. Li D, Yue L, Peng X, Chen L, Lin T, Huang L, et al. Yerba maté and its impact on glycemic control and metabolic health: a systematic review and meta-analysis. Front Endocrinol (Lausanne). 2025;16:1641592. https://doi.org/10.3389/fendo.2025.1641592
9. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. https://doi.org/10.1136/bmj.n71
10. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898. https://doi.org/10.1136/bmj.l4898
11. Sterne JAC, Hernán MA, Reeves BC, Savović J, Berkman ND, Viswanathan M, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ. 2016;355:i4919. https://doi.org/10.1136/bmj.i4919
12. Viechtbauer W. Conducting meta-analyses in R with the metafor package. J Stat Softw. 2010;36(3):1-48. https://doi.org/10.18637/jss.v036.i03
13. de Morais EC, Stefanuto A, Klein GA, Boaventura BC, de Andrade F, Wazlawik E, et al. Consumption of yerba mate (Ilex paraguariensis) improves serum lipid parameters in healthy dyslipidemic subjects and provides an additional LDL-cholesterol reduction in individuals on statin therapy. J Agric Food Chem. 2009;57(18):8316-8324. https://doi.org/10.1021/jf901660g
14. Klein GA, Stefanuto A, Boaventura BC, de Morais EC, Cavalcante LS, de Andrade F, et al. Mate tea (Ilex paraguariensis) improves glycemic and lipid profiles of type 2 diabetes and pre-diabetes individuals: a pilot study. J Am Coll Nutr. 2011;30(5):320-332. https://doi.org/10.1080/07315724.2011.10719975
15. Boaventura BC, Di Pietro PF, Stefanuto A, Klein GA, de Morais EC, de Andrade F, et al. Association of mate tea (Ilex paraguariensis) intake and dietary intervention and effects on oxidative stress biomarkers of dyslipidemic subjects. Nutrition. 2012;28(6):657-664. https://doi.org/10.1016/j.nut.2011.10.017
16. Messina D, Soto C, Méndez A, Corte C, Kemnitz M, Avena V, et al. Efecto hipolipemiante del consumo de mate en individuos dislipidémicos. Nutr Hosp. 2015;31(5):2131-2139. https://doi.org/10.3305/nh.2015.31.5.8386
17. Avena V, Messina D, Corte C, Mussi J, Sáez A, Boarelli P, et al. Asociación entre el consumo de yerba mate y el perfil lipídico en mujeres con sobrepeso. Nutr Hosp. 2019;36(6):1300-1306. https://doi.org/10.20960/nh.02599
18. Souza SJ, Petrilli AA, Teixeira AM, Pontilho PM, Carioca AA, Luzia LA, et al. Effect of chocolate and mate tea on the lipid profile of individuals with HIV/AIDS on antiretroviral therapy: a clinical trial. Nutrition. 2017;43-44:61-68. https://doi.org/10.1016/j.nut.2017.06.017
19. Bravo L, Martínez-López S, Sierra-Cinos JL, Mateos R, Sarriá B. Yerba mate (Ilex paraguariensis St. Hill.) tea may have cardiometabolic beneficial effects in healthy and at-risk subjects: a randomized, controlled, blind, crossover trial in nonhabitual consumers. Mol Nutr Food Res. 2025;69(15):e70065. https://doi.org/10.1002/mnfr.70065
20. Chaves G, Britiz N, Oviedo G, González G, Italiano C, Blanes M, et al. Heavy drinkers of Ilex paraguariensis beverages show lower lipid profiles but higher body weight. Phytother Res. 2018;32(6):1030-1038. https://doi.org/10.1002/ptr.6041
21. da Veiga DTA, Bringhenti R, Copes RM, Tatsch E, Moresco RN, Comim FV, et al. Protective effect of yerba mate intake on the cardiovascular system: a post hoc analysis study in postmenopausal women. Braz J Med Biol Res. 2018;51(6):e7253. https://doi.org/10.1590/1414-431X20187253