International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

Collagen Supplementation on Tendon-Related Structural and Performance Outcomes: A Systematic Review

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 19 November 2025 and was last updated on 19 November 2025.

INTRODUCTION

Review question / Objective The purpose of this systematic review is to critically evaluate the effects of collagen supplementation on tendon-related structural and performance outcomes, including tendon CSA, stiffness, Young's modulus, muscle strength, muscle CSA, and physical performance.

Rationale Mechanical loading is the primary driver of tendon remodeling, stimulating increases in tendon cross-sectional area, stiffness, and material quality. Collagen supplementation has emerged as a potential adjunct to enhance these adaptations because hydrolyzed collagen and collagen peptides provide amino acids essential for collagen synthesis—particularly glycine, proline, and hydroxyproline—and demonstrate peak serum availability when ingested approximately 60 minutes prior to loading. Early mechanistic work suggests that collagen, especially when co-ingested with vitamin C, may augment exercise-induced collagen synthesis; however, findings across human trials have been inconsistent, with variability in protocols, doses, training intensities, and outcome measures limiting clear application in practice.

Given the growing clinical and performance interest in collagen for tendon health—and the absence of consensus regarding its efficacy, dosing, timing, and role relative to resistance training—there is a critical need to systematically evaluate the current randomized controlled trial evidence. This review synthesizes tendon structural outcomes (CSA, stiffness, Young's modulus), muscle adaptations, and performance metrics to determine whether collagen supplementation provides meaningful benefits beyond exercise alone, and to establish evidence-based recommendations for its use in athletic and rehabilitative settings.

Condition being studied Tendon health is essential for force transmission, joint stability, and efficient movement. Tendons are composed primarily of Type I collagen and adapt to mechanical loading by increasing cross-sectional area, stiffness, and material quality. When these adaptive processes are insufficient—or when tendons are exposed to excessive or repetitive strain—individuals may develop tendon dysfunction, including reduced stiffness, impaired load tolerance, and pain. Tendon-related conditions are common in both athletic and general populations and can significantly limit performance and mobility.

Because tendon remodeling depends on collagen synthesis and mechanotransduction, nutritional strategies such as collagen supplementation have been proposed to support or enhance the tendon's adaptive response to loading. However, evidence across trials has been inconsistent, creating uncertainty about dosing, timing, and clinical usefulness. This review addresses that gap by synthesizing current randomized controlled trial data on how collagen supplementation influences tendon structure, mechanical properties, and performance outcomes.

METHODS

Search strategy A comprehensive search of PubMed, EMBASE, CINAHL, and Web of Science was conducted.

PubMed (211)

("hydroly* collagen*"[tw] OR "collagen supplementation"[tiab:~5] OR "collagen supplementations"[tiab:~5] OR "gelatin supplementation"[tiab:~5] OR "gelatin supplementations"[tiab:~5] OR "glycine supplementation"[tiab:~5] OR "glycine supplementations"[tiab:~5] OR "proline supplementation"[tiab:~5] OR "proline supplementations"[tiab:~5] OR (("Collagen"[MeSH] OR collagen[tiab] OR gelatin[tiab] OR "Gelatin"[MeSH] OR "glycine"[mesh] OR glycine[tiab] OR proline[mesh] OR proline[tiab]) AND ("Dietary Supplements"[mesh] OR supplement*[tiab] OR "administration and dosage"[sh] OR oral*[tiab] OR intake*[tiab] OR "Administration, Oral"[mesh] OR dietary[tiab]))) AND (tendons[mesh] OR tendinopathy[mesh] OR tendinopath* OR tendinitis[tiab] OR tendon*[tiab] OR "tendon injuries"[mesh] OR ((Tear* [tiab] OR torn*[tiab] OR injur* [tiab] OR rupture* [tiab] OR sprain* [tiab] OR strain* [tiab]) AND (elbow*[tw] OR shoulder*[tw] OR ankle*[tw] OR glute*[tw] OR Achilles[tw] OR supraspinatus[tw] OR patella*[tw] OR "greater trochanter*"[tw] OR heel*[tw] OR "plantar fasci*"[tw]))) NOT (animals[mesh] NOT humans[mesh]) NOT ("vitro"[ti] NOT "vivo"[ti]) NOT (rat[ti] OR rats[ti] OR matrix[ti] OR graft*[ti] OR "stem cell*"[ti] OR model[ti] OR inject*[ti] OR matrices[ti])

Embase (264)

('hydroly* collagen*':ti,ab,kw OR (((collagen OR gelatin) NEAR/6 supplement*):ti,ab,kw) OR (('collagen'/exp OR collagen:ti,ab OR gelatin:ti,ab OR 'gelatin'/exp OR 'glycine'/exp OR glycine:ti,ab OR 'proline'/exp OR proline:ti,ab) AND ('dietary supplement'/exp OR 'diet supplementation'/exp OR supplement*:ti,ab OR 'drug dose'/lnk OR 'oral drug administration'/lnk OR oral*:ti,ab OR intake*:ti,ab OR 'oral drug administration'/exp OR dietary:ti,ab))) AND ('tendon'/exp OR 'tendon disease'/exp OR tendinopath* OR tendinitis:ti,ab OR tendon*:ti,ab OR 'tendon injuries':ti,ab OR ((tear*:ti,ab OR torn*:ti,ab OR injur*:ti,ab OR rupture*:ti,ab OR sprain*:ti,ab OR strain*:ti,ab) AND (elbow*:ti,ab,kw OR shoulder*:ti,ab,kw OR ankle*:ti,ab,kw OR glute*:ti,ab,kw OR achilles:ti,ab,kw OR supraspinatus:ti,ab,kw OR patella*:ti,ab,kw OR 'greater trochanter*':ti,ab,kw OR heel*:ti,ab,kw OR 'plantar fasci*':ti,ab,kw))) NOT ('animal'/exp NOT 'human'/exp) NOT ('vitro':ti NOT 'vivo':ti) NOT ('rat':ti OR 'rats':ti OR matrix:ti OR graft*:ti OR 'stem cell*':ti OR model:ti OR inject*:ti OR matrices:ti) NOT ('chapter'/it OR 'conference abstract'/it)

CINAHL (95)

("hydroly* collagen*" OR ((collagen OR gelatin) N6 supplement*) OR ((MH "Collagen" OR collagen OR gelatin OR MH"glycine+" OR glycine OR MH "proline" OR proline) AND (MH "Dietary Supplements+" OR MH "dietary supplementation" OR supplement*:ti,ab OR MW"AD" OR oral* OR intake* OR MH "administration, oral+" OR dietary))) AND (MH "tendons" OR MH "tendon injuries+" OR MH" tendinopathy+" OR tendinopath* OR tendinitis OR tendon* OR "tendon injur*" OR ((Tear* OR torn* OR injur* OR rupture* OR sprain* OR strain*) AND (elbow* OR shoulder* OR ankle* OR glute* OR Achilles OR supraspinatus OR patella* OR "greater trochanter*" OR heel* OR "plantar fasci*"))) NOT (MH "animal" NOT MH "human") NOT (TI "vitro" NOT TI "vivo") NOT (TI"rat" OR TI"rats" OR TI"matrix" OR TI"graft*" OR TI"stem cell*" OR TI "model" OR TI"inject" OR TI" matrices")

Web of Science (317) Science Citation Index Expanded (SCI-EXPANDED)--1900-present

(TS=(("hydroly* collagen*" OR ((collagen OR gelatin) NEAR/6 supplement*) OR ((collagen OR gelatin OR glycine OR proline) AND ("Diet* Supplement*" OR supplement* OR dosage OR administration OR oral* OR intake* OR dietary OR diet OR diets))) AND (tendinopath* OR tendinitis OR tendon* OR "tendon injur*" OR ((Tear* OR torn* OR injur* OR rupture* OR sprain* OR strain*) AND (elbow* OR shoulder* OR ankle* OR glute* OR Achilles OR supraspinatus OR patella* OR "greater trochanter*" OR heel* OR "plantar fasci*")))) NOT (TI=(vitro) NOT TI=(vivo)) NOT TI=("rat" OR "rats" OR "matrix" OR "graft*" OR "stem cell*" OR "model" OR "inject*" OR "matrices")) NOT (DT==("BOOK CHAPTER" OR "MEETING ABSTRACT") OR TASCA==("MEDICAL LABORATORY TECHNOLOGY" OR "PHYSICS APPLIED" OR "PHYSICS CONDENSED MATTER" OR "AGRICULTURE MULTIDISCIPLINARY" OR "ENTOMOLOGY" OR "ENGINEERING MULTIDISCIPLINARY" OR "ENVIRONMENTAL SCIENCES" OR "EVOLUTIONARY BIOLOGY" OR "INSTRUMENTS INSTRUMENTATION" OR "MATERIALS SCIENCE COMPOSITES" OR "METALLURGY METALLURGICAL ENGINEERING" OR "MICROSCOPY" OR "PARASITOLOGY" OR "PHYSICS NUCLEAR" OR "PHYSICS ATOMIC MOLECULAR CHEMICAL" OR "POLYMER SCIENCE" OR "TRANSPLANTATION" OR "GEOSCIENCES MULTIDISCIPLINARY" OR "ENGINEERING CHEMICAL" OR "CHEMISTRY PHYSICAL" OR "CHEMISTRY ANALYTICAL" OR "ARCHAEOLOGY" OR "ZOOLOGY" OR "ANTHROPOLOGY" OR "CHEMISTRY APPLIED" OR "PLANT SCIENCES" OR "MICROBIOLOGY" OR "MATERIALS SCIENCE MULTIDISCIPLINARY" OR "AGRICULTURE DAIRY ANIMAL SCIENCE" OR "BIOCHEMICAL RESEARCH METHODS" OR "MATERIALS SCIENCE BIOMATERIALS" OR "CELL TISSUE ENGINEERING" OR "CHEMISTRY MULTIDISCIPLINARY" OR "MULTIDISCIPLINARY SCIENCES" OR "VETERINARY SCIENCES" OR "BIOPHYSICS" OR "BIOTECHNOLOGY APPLIED MICROBIOLOGY")).

Participant or population Include: Studies involving human participants of any age, sex, or ethnicity. Participants with healthy tendons or pathological tendons.
Exclude: Studies involving animal models or non-human subjects. Studies focusing exclusively on populations with underlying comorbidities that may confound tendon health (e.g., severe systemic diseases).

Intervention Include: Studies that investigate collagen supplementation (including hydrolyzed collagen, gelatin, or collagen peptides). Studies that include proline or glycine as part of the supplementation regimen.
Exclude: Studies that do not specifically investigate collagen, gelatin, proline, or glycine supplementation.

Comparator Include: Studies that include a control group receiving either a placebo or no treatment. Studies comparing different types collagen supplementation.
Exclude: Studies without a control group or appropriate comparison group.

Study designs to be included Randomized controlled trials (RCTs), cohort studies, case-control studies. Hand selected articles that come from the review of references of the included studies.

Eligibility criteria Other: Include: Language: Studies published in English., Exclude: Language: Studies published in languages other than English.

Information sources The review relied exclusively on electronic databases. No trial registers, author contact, or grey literature sources were used. The databases searched were:
PubMed
EMBASE
CINAHL
Web of Science
Hand-searching of the reference lists of included studies was also performed to identify any additional eligible articles.

Main outcome(s) 1. Tendon Structural Outcomes
Tendon Cross-Sectional Area (CSA)
Timing: Baseline and post-intervention
Effect Measures: Percentage change, absolute CSA, group × time interaction
Tendon Stiffness
Timing: Baseline and post-intervention
Effect Measures: Absolute stiffness (N/mm), percentage change, group × time interaction
Young's Modulus
Timing: Baseline and post-intervention
Effect Measures: Material modulus (GPa), percentage change, group × time interaction
2. Muscle Outcomes
Muscle Cross-Sectional Area / Muscle Thickness
Timing: Baseline and post-intervention
Effect Measures: MRI-derived muscle volume, ultrasound muscle thickness, percentage change
Muscle Strength
Timing: Baseline and post-intervention
Effect Measures: 1RM tests, isometric maximal voluntary contraction, 10RM tests, group × time interaction

3. Physical and Neuromuscular Performance Outcomes
Jump and Power Metrics (e.g., countermovement jump, squat jump, broad jump)
Timing: Baseline and post-intervention
Effect Measures: Jump height, impulse, peak power
Rate of Force Development (RFD)
Timing: Baseline and post-intervention
Effect Measures: RFD at specific time intervals (e.g., 0–50 ms, 0–100 ms), eccentric RFD, deceleration impulse, group × time interaction.

Data management All search results from the electronic databases were imported into a citation manager (Zotero) where duplicate records were identified and removed. The deduplicated records were then uploaded into a systematic review management platform (Covidence) for screening and data handling.
Two independent reviewers screened titles, abstracts, and full texts within Covidence according to the predefined inclusion and exclusion criteria. Covidence was used to track study decisions, resolve discrepancies through discussion, and maintain an audit trail of all screening actions.
Data extraction was also performed within Covidence using pre-specified data fields based on the PICO framework. Extracted data included participant characteristics, intervention details, comparison conditions, training protocols, outcome measures, and study results. Covidence stored all extracted data, ensured version control, and maintained organization of all study records throughout the review process.

Quality assessment / Risk of bias analysis Quality assessment of all included randomized controlled trials was performed using the Physiotherapy Evidence Database (PEDro) scale. Two independent reviewers conducted the PEDro evaluations, scoring each study across its 11 criteria (with 10 contributing to the final score). Discrepancies between reviewers were resolved through discussion until consensus was reached.
The PEDro scale assesses internal validity and reporting quality, including randomization, allocation concealment, baseline comparability, blinding procedures, follow-up completeness, intention-to-treat analysis, and adequacy of statistical reporting. Based on standard PEDro thresholds, studies scoring 6–8 were classified as good quality, and studies scoring 9–10 as excellent quality.
In addition, the Oxford Centre for Evidence-Based Medicine (OCEBM) level-of-evidence framework and the GRADE approach were applied to categorize the overall strength of evidence and recommendation level for each outcome domain. These approaches are endorsed by the American Physical Therapy Association for evaluating evidence within clinical practice guidelines.

Strategy of data synthesis Data from all included studies were synthesized narratively due to methodological heterogeneity in supplementation protocols, training interventions, dosing strategies, outcome measures, and study durations. Extracted pre- and post-intervention values were organized by outcome domain, including tendon structure, mechanical properties, muscle morphology, muscle strength, and physical performance.
Where reported, studies' effect measures—such as absolute change, percentage change, and group × time interactions—were extracted directly from the original trials. Outcomes were presented in structured tables and figures to facilitate comparison across collagen type, dosage, timing of ingestion, training mode, and intervention duration.
Because of heterogeneity in measurement techniques, imaging methods, anatomical regions analyzed, and resistance-training prescriptions, no meta-analysis was planned or performed. Instead, a structured narrative synthesis was used to identify patterns and summarize how individual study characteristics related to changes in tendon adaptation and performance outcomes.

Subgroup analysis No subgroup analyses were conducted for this review. Variability in collagen dosage, training protocols, participant characteristics, and outcome measures across the included randomized controlled trials prevented meaningful subgroup stratification. As a result, all data were synthesized narratively without division into predefined subgroups.

Sensitivity analysis No sensitivity analyses were performed. Differences in study design, collagen dosage, training protocols, and outcome measurement methods across the included randomized controlled trials prevented the use of sensitivity testing. All results were therefore synthesized narratively without additional robustness checks.

Country(ies) involved United States.

Keywords Collagen supplementation; Hydrolyzed collagen; Collagen peptides; Vitamin C; Tendon cross-sectional area; Tendon stiffness; Young's modulus; Tendon adaptation; Resistance training; Plyometric.

Dissemination plans The findings from this systematic review will be disseminated through multiple channels. The primary plan is to submit the completed review for publication in a peer-reviewed scientific journal relevant to sports medicine, rehabilitation, or clinical nutrition. In addition, the results will be shared with clinicians, including physical therapists, sports medicine providers, and performance professionals, to help inform evidence-based practice. Findings may also be presented at professional conferences, seminars, or institutional meetings to reach broader academic and clinical audiences.

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