Journal of Bodywork & Movement Therapies 46 (2026) 346–355

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

Is cryotherapy effective for tendon health? A systematic review of evidence and methodological limitations☆

Tatiana Araújo Lima [a], Thiago Santos Rocha [b], Márcio Almeida Bezerra [a], Rodrigo Ribeiro de Oliveira [a,*]

[a] Tendon Research Group, Physical Therapy and Functioning Physical Therapy Department, Federal University of Ceara, Fortaleza, CE, Brazil
[b] Tendon Research Group, Physical Therapy Department, Federal University of Ceara, Fortaleza, CE, Brazil

ARTICLE INFO

Keywords:
Cryotherapy
Tendon
Tendinopathy
Therapeutic hypothermia

ABSTRACT

Background: Cryotherapy is widely used in managing soft tissue injuries, but its scientific foundation and clinical application remain inconsistent. Human evidence—especially concerning tendinopathy—is limited and heterogeneous. Understanding the effects of cold exposure on tendon structure and function is essential for safer and more effective clinical practice.
Objective: To systematically review the clinical, mechanical, and physiological effects of cryotherapy on human tendons, both healthy and affected by tendinopathy.
Methods: Comprehensive searches were conducted in CENTRAL, MEDLINE, EMBASE, CINAHL, and PEDro. Studies including human participants exposed to cryotherapy and assessing tendon-related outcomes were eligible. From 1075 records screened, 12 studies met inclusion criteria.
Results: Among the 12 included studies, seven (58.3 %) were randomized or quasi-randomized, four (33.3 %) experimental, and one (8.3 %) observational. Nine studies (75 %) used ice and three (25 %) used cold- or ice-water immersion. Cryotherapy was applied either as a standalone treatment (five studies, 41.7 %) or combined with other therapies (seven, 58.3 %) such as exercise, ultrasound, compression, or taping. Short-term improvements were reported in pain and microcirculatory parameters, suggesting potential benefits when used as an adjunct. However, methodological limitations—small samples, limited follow-up, and heterogeneous outcomes—restrict the strength and generalizability of findings.
Conclusions: Current evidence does not support cryotherapy as a standalone or standard treatment for tendinopathy. It may serve as an adjunctive strategy for short-term symptom relief, but its long-term structural or functional benefits remain uncertain. High-quality randomized controlled trials are required to clarify its therapeutic role.

1. Introduction

Cryotherapy is widely used in the treatment of soft tissue injuries, yet the supporting evidence remains limited (Racinais et al., 2024). The term cryotherapy broadly refers to therapeutic interventions involving the application of cold temperatures. It is defined as a technique that reduces tissue temperature by extracting heat from the body. The extent of tissue cooling depends on factors such as duration and method of application, anatomical location, and the thickness of subcutaneous fat (Bassett et al., 1992; Merrick et al., 1993; Mac Auley, 2001). The proposed benefits of cryotherapy include reduced metabolic activity, inflammation, swelling, hematoma formation, and limitation of secondary injury (Knight et al., 2000; Enwemeka et al., 2002; Bleakley et al., 2004; Capps and Brook, 2009; Kwiecien and McHugh, 2021).

However, most of this evidence stems from animal models, which pose significant limitations when extrapolated to humans. Rodents exhibit distinct muscular and metabolic properties, and intramuscular temperatures observed in these models—often below 20 °C—have not been consistently replicated in human studies (Kowalski and Bruce, 2014; Bleakley et al., 2010; Bleakley et al., 2012). Despite these

☆ The study was approved by the research ethics committee of the Universidade Federal do Ceará.

* Corresponding author. Federal University of Ceará, Rua Major Wayne 1440, Physical Therapy Department, Rodolfo Teófilo, Fortaleza, Ceará, Brazil.
E-mail addresses: correiodatat@gmail.com (T.A. Lima), tsantosrocha11@gmail.com (T.S. Rocha), marcioab@ufc.br (M.A. Bezerra), rodrigo@ufc.br (R.R. Oliveira).

https://doi.org/10.1016/j.jbmt.2025.11.015
Received 3 April 2025; Received in revised form 1 November 2025; Accepted 10 November 2025
Available online 19 November 2025

limitations, cryotherapy remains widely used in clinical practice, often without a comprehensive understanding of its effects in human tissues.

Although a few investigations have been conducted in humans, these studies are scarce and heterogeneous in design, typically involving small sample sizes, short follow-up periods, and variable cryotherapy protocols. For instance, Dupuis et al. (2018) evaluated cryotherapy versus progressive loading in rotator cuff tendinopathy with no significant differences between groups, while Romero-Morales et al. (2019) combined cold-water immersion with eccentric exercises in Achilles tendinopathy and reported structural but not clinical changes. Similarly, Rayjade et al. (2020) and Durgut et al. (2024) investigated cryotherapy combined with ultrasound or kinesiotaping, highlighting the frequent coexistence of multimodal approaches and the lack of protocol standardization. Such methodological heterogeneity limits the comparability of results and the understanding of cryotherapy's isolated effects on human tendons.

Several variables complicate the clinical application of cryotherapy, including the heterogeneous nature of soft tissues (e.g., muscles, tendons, ligaments), the type and chronicity of the injury, anatomical location, and local adipose tissue thickness (Wang and Ni, 2021). Given these uncertainties and knowledge gaps, a systematic review of the literature was warranted to identify and synthesize the available evidence on how cryotherapy affects tendon structure and function.

Understanding the mechanisms by which cryotherapy influences tendons is critical for informed clinical decision-making, particularly in the management of tendinopathies. These conditions are increasingly prevalent across all age groups, affecting both athletes and non-athletes (Hopkins et al., 2016; Asplund and Best, 2013; De Vos et al., 2021), and involve complex changes in tendon microstructure and composition. According to the consensus from the International Scientific Tendinopathy Symposium (Scott et al., 2020), tendinopathy is characterized by persistent tendon pain and functional loss in response to mechanical loading. Its prevalence varies by anatomical location and is influenced by factors such as age, sex, type of sport or physical activity, occupational demands, and comorbidities (Millar et al., 2021). This review seeks to bridge the gap between experimental evidence and clinical application by critically evaluating the current knowledge on the effects of cryotherapy on tendon structure and function in humans.

This systematic review was designed to examine the literature and analyze studies investigating the effects of cryotherapy on tendons in human subjects. The objectives were organized into two categories to enhance clarity and structure. The **primary objective** was to analyze randomized controlled trials (RCTs), recognized as the gold standard in clinical research, that investigated cryotherapy as a therapeutic intervention in patients with tendinopathy, specifically assessing clinically relevant outcomes such as pain and function. The **secondary objectives** included experimental and observational studies that explored mechanical and physiological outcomes, offering complementary insights to support clinical interpretation.

2. Methods

2.1. Study design

This study is a systematic review conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The protocol was developed and registered in the PROSPERO database under the registration number CRD42024584999.

2.2. Eligibility criteria

Eligible studies were those conducted in human adults (≥18 years), that investigated cryotherapy as the primary intervention, and evaluated its clinical, mechanical, or physiological effects on either healthy tendons or tendons affected by tendinopathy. Cryotherapy could be applied either as a standalone intervention or in combination with placebo or other therapeutic approaches. Studies with or without a comparator group—including no intervention, wait-list control, placebo, alternative cryotherapy protocols, or any other non-surgical intervention—were considered eligible.

Exclusion criteria included animal studies, in vitro studies, case reports, pilot studies, conference abstracts, review protocols, systematic reviews, grey literature, articles not available in full text, cold spray cryotherapy, and studies evaluating postoperative tendon injuries.

2.3. Search strategy and study selection

The search strategy was guided by the following research question: *What are the clinical, mechanical, and physiological effects of cryotherapy on tendon structure and function?* Cryotherapy was defined as any non-invasive intervention applied to the body involving the use of ice or cold water, cold gel packs, cold-water immersion, or ice massage.

Searches were conducted up to November 13, 2024, and subsequently updated in September 2025**,** without restrictions regarding age, gender, language, date of publication, or geographic location. The following electronic databases were searched: CENTRAL (Cochrane Central Register of Controlled Trials, The Cochrane Library), MEDLINE (via PubMed), EMBASE, CINAHL, and PEDro (Physiotherapy Evidence Database). All databases were searched from their inception.

In addition to the electronic database searches, the reference lists of all full-text articles included in the review were manually screened to identify any additional potentially relevant studies not captured through the initial search strategy. This step was performed to ensure comprehensive coverage of the literature relevant to the topic.

The search strategies included the following keyword combinations.

2.4. MEDLINE (Pubmed)

((tendinopathies) OR (tendinopathy) OR (tendinoses) OR (tendinosis) OR (tendinous) OR (tendon) OR (tendons) OR (tendon injury) OR (tendon damage) OR (tendinitis) OR (tendonitis)) AND ((cryotherapy) OR (ice therapy) OR (cold therapy) OR (hypothermia) OR (ice application) OR (cold pack) OR (ice treatment) OR (cold compress))

2.5. CENTRAL (Cochrane Central Register of Controlled Trials, The Cochrane Library)

((tendinopathies) OR (tendinopathy) OR (tendinoses) OR (tendinosis) OR (tendinous) OR (tendon) OR (tendons) OR (tendon injury) OR (tendon damage) OR (tendinitis) OR (tendonitis)).

AND

((cryotherapy) OR (ice therapy) OR (cold therapy) OR (hypothermia) OR (ice application) OR (cold pack) OR (ice treatment) OR (cold compress)).

2.6. CINAHL

(tendinopathies) OR (tendinopathy) OR (tendinoses) OR (tendinosis) OR (tendinous) OR (tendon) OR (tendons) OR (tendon injury) OR (tendon damage) OR (tendinitis) OR (tendonitis) AND (cryotherapy) OR (ice therapy) OR (cold therapy) OR (hypothermia) OR (ice application) OR (cold pack) OR (ice treatment) OR (cold compress).

2.7. EMBASE

(tendinopathies OR 'tendinopathy'/exp OR tendinopathy OR tendinoses OR tendinous OR 'tendon'/exp OR tendon OR tendinosis OR 'tendinosis'/exp OR tendons OR 'tendons'/exp OR 'tendonitis'/exp OR tendonitis OR 'tendinitis'/exp OR tendinitis).

AND

('cryotherapy'/exp OR cryotherapy OR (('ice'/exp OR ice) AND ('therapy'/exp OR therapy)) OR (('cold'/exp OR cold) AND ('application'/exp OR application)) OR (('cold'/exp OR cold) AND ('therapy'/exp OR therapy)) OR (('cold'/exp OR cold) AND pack)) OR hypothermia OR 'hypothermia'/exp OR (('cold'/exp OR cold) AND ('compress'/exp OR compress)).

2.8. PEDro (Physiotherapy Evidence Database)

2.8.1. Tendon – Electrotherapies, heat, cold [Advanced search]

Two independent reviewers (TL and TR) screened the titles and abstracts of potentially eligible studies using the Rayyan® web application (developed by the Qatar Computing Research Institute – QCRI, a non-profit organization based in Qatar) (Ouzzani et al., 2016). Full-text articles were then assessed to determine final eligibility. In cases of disagreement, a third reviewer (RRO) was consulted to reach consensus.

2.9. Data extraction and management

Data extraction and management were conducted by two independent reviewers (TL and TR) using a pre-structured Excel spreadsheet. Discrepancies were resolved through discussion, or by arbitration of a third reviewer (RRO) when necessary. The extracted information included bibliometric data (author, year of publication), study characteristics (sample size, design, intervention description, duration and frequency of cryotherapy, and the use of co-interventions), and the presence or absence of comparator groups. Participant characteristics (sex, age, diagnosis of tendinopathy, and anatomical site targeted by the intervention) were also recorded.

Outcomes were classified into three main domains. **Clinical outcomes** were operationalized through Patient-Reported Outcome Measures (PROMs), which included validated instruments assessing pain, function, and health-related quality of life, such as the Visual Analogue Scale (VAS), Numeric Pain Rating Scale (NPRS), Disabilities of the Arm, Shoulder and Hand (DASH), Shoulder Pain and Disability Index (SPADI), and Western Ontario Rotator Cuff Index (WORC). **Mechanical outcomes** referred to tendon structural and biomechanical properties, such as stiffness, viscoelasticity, and tensile strength, which were typically quantified through biomechanical testing or advanced imaging techniques. **Physiological outcomes** comprised microcirculatory parameters (e.g., capillary blood flow, tissue oxygenation, venous return) and tendon morphology (e.g., thickness, cross-sectional area), most often evaluated by ultrasound image or other imaging modalities combined with physiological monitoring methods.

2.10. Methodological quality and risk of bias

Methodological quality and risk of bias were independently assessed by two reviewers (TL and TR). For randomized controlled trials, the Cochrane Collaboration's Risk of Bias 2 tool (RoB 2) (Sterne et al., 2019) was applied. This tool evaluates five domains of potential bias (randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results), classifying studies as "low risk," "some concerns," or "high risk."

In parallel, the PEDro scale (Maher et al., 2003; Shiwa et al., 2011) was applied because it is widely used in physiotherapy and rehabilitation research to appraise methodological quality and reporting standards of clinical trials, while also enabling comparability with previous systematic reviews in the field. The scale consists of 10 scoring items (0–10), covering aspects such as randomization, allocation concealment, blinding, intention-to-treat analysis, and follow-up completeness. Trials scoring ≥6 were classified as having moderate-to-high methodological quality, whereas those scoring <6 were considered lower quality. When available, PEDro scores were retrieved directly from the PEDro database; otherwise, they were independently assessed by the reviewers, with disagreements resolved by consensus or arbitration (RRO). By combining these two complementary tools, our review provided both a standardized quantitative appraisal of methodological quality (PEDro) and a domain-specific evaluation of risk of bias (RoB 2), thereby enhancing transparency and methodological rigor.

For non-randomized and experimental studies, methodological quality and potential biases were described narratively due to the heterogeneity of study designs and outcomes. This approach allowed us to highlight key strengths and limitations without applying inappropriate standardized criteria.

3. Results

3.1. Search results and general characteristics of the included studies

The search strategy identified a total of 1075 records across electronic databases and trial registers (PubMed/MEDLINE = 480; Embase = 60; Cochrane Library = 158; PEDro = 142; CINAHL = 235). After removing 300 duplicates, 775 unique records remained. Screening of titles and abstracts led to the exclusion of 753 records that did not meet the predefined eligibility criteria, leaving 22 articles for full-text retrieval and assessment. Of these, two articles could not be retrieved, resulting in 20 full-text articles assessed for eligibility. Ten of these were excluded: three were protocol records, four did not include cryotherapy-related tendon outcomes, one was a pilot study, one was published only in conference proceedings, and one did not meet other eligibility criteria. In addition, manual screening of the reference lists of eligible articles identified two further studies. Ultimately, 12 studies were included in the qualitative synthesis, corresponding to 12 reports of included studies. A flow diagram illustrating the study screening and selection process is presented in Fig. 1.

Of the 12 included studies, six (50.0 %) were randomized controlled trials, one (8.3 %) was a quasi-RCT, four (33.3 %) were experimental studies, and one (8.3 %) was observational. Regarding the type of cryotherapy, nine studies (75.0 %) applied ice, while three (25.0 %) used cold- or ice-water immersion. In terms of intervention design, five studies (41.7 %) investigated cryotherapy as a standalone treatment, whereas seven (58.3 %) combined cryotherapy with other modalities such as exercise, ultrasound, compression, or taping. Concerning the anatomical site of application, eight studies (66.7 %) targeted tendons of the lower limbs and four (33.3 %) investigated upper-limb tendons.

With respect to outcomes, six studies (50.0 %) evaluated mechanical outcomes, five (41.7 %) assessed physiological parameters, and five (41.7 %) investigated clinical outcomes related to pain and function.

Among the seven randomized controlled trials included in this review, the majority (85.7 %) investigated the effects of cryotherapy in the management of tendinopathies, while only one study (14.3 %) assessed cryotherapy in healthy tendons, focusing specifically on microcirculatory responses (Knobloch et al., 2008). In total, six studies evaluated the application of cryotherapy—either as a standalone intervention or combined with other therapeutic modalities—in individuals diagnosed with tendinopathy.

Altogether, the included RCTs involved 379 participants. Of these, 319 individuals (84.2 %) had clinically diagnosed tendinopathy, and 60 (15.8 %) presented with healthy tendons. The clinical conditions assessed varied across trials and included rotator cuff tendinopathy, Achilles tendinopathy, patellar tendinopathy, biceps tendinopathy, and supraspinatus tendinopathy.

The modalities of cryotherapy applied also differed among studies. Interventions ranged from localized ice application and cryotherapy-compression systems to cold-water immersion, often combined with resistance exercise, vibration therapy, ultrasound, taping, or postural correction techniques. Outcome measures varied and included clinical parameters (such as pain, function, and range of motion), mechanical outcomes (such as strength), and physiological responses (such as tendon thickness and inflammatory markers measured via imaging techniques). Table 1 summarizes the main characteristics and findings of

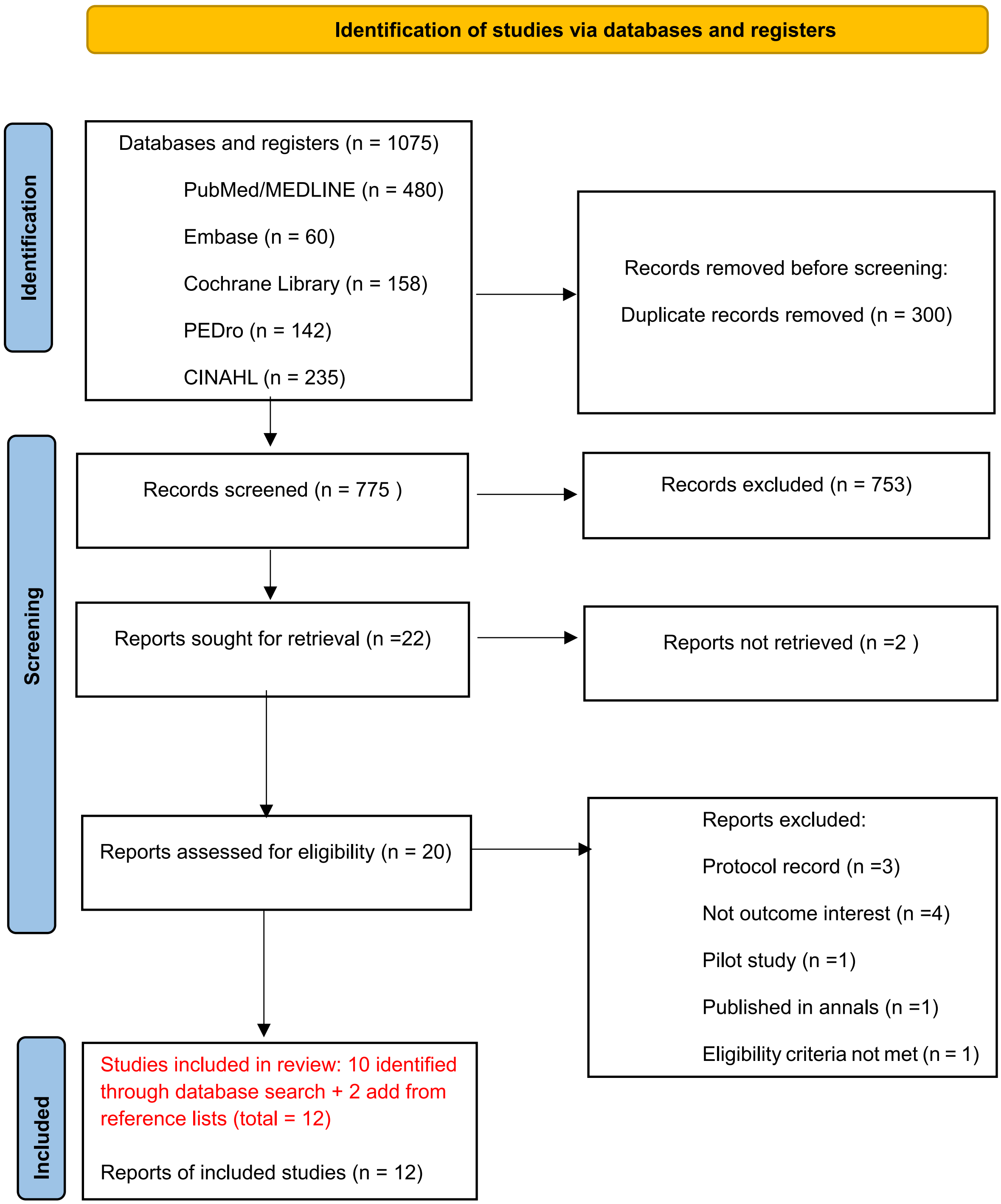

Fig. 1. – PRISMA flow diagram.

the RCT.

When considering the five studies that investigated cryotherapy as a standalone intervention, no relevant clinical, functional, or structural effects were observed. Kubo et al. (2005) and Muraoka et al. (2008) reported no significant changes in tendon mechanical properties after cold-water immersion, while Alegre et al. (2016) found only a slight, clinically irrelevant increase in tendon stiffness. Among the randomized controlled trials, Dupuis et al. (2018) detected no therapeutic advantage of cryotherapy compared with progressive loading exercise in rotator cuff tendinopathy, and Durgut et al. (2024) reported pain reductions comparable to those of the control group, without additional functional gains. Overall, isolated cryotherapy has not demonstrated a consistent therapeutic effect on pain, function, or tendon properties.

3.2. *Cryotherapy in the treatment of tendinopathies*

Six randomized controlled trials evaluated the use of cryotherapy—either alone or in combination with other therapies—for the treatment of tendinopathies. The designs, populations, interventions, and outcomes varied across studies, allowing for a broader understanding of how cryotherapy may influence clinical, mechanical, and physiological parameters in different tendon conditions (Table 2). Additionally, Table 3 summarizes the clinical outcomes reported across studies, specifically highlighting chages in pain and functional

Table 1
– General characteristics of the included studies.

AUTHOR/YEAR	TYPE OF STUDY	INTERVENTION	DURATION AND FREQUENCY OF INTERVENTION	OUTCOME
Kubo et al. (2005)	Experimental study	**Cryotherapy**	Leg immersion in 5° water for 30 min (1 application)	**Mechanical**: viscoelastic properties – passive stretching
Knobloch et al. (2006)	Experimental study	**Cryotherapy + compression (Cryo/Cuff®)**	Three sessions of 10 min each followed by a 10 min recovery period.	**Physiological** – tendon microcirculation
Knobloch et al. (2007)	Prospective observational cohort study	**Cryotherapy (KoldBlue®)**	Three sessions of 10 min each, followed by a 10 min recovery period.	**Physiological** – tendon microcirculation
Knobloch et al. (2008)	RCT	**Cryotherapy(KoldBlue®) *vs.* Cryotherapy + compression (Cryo/Cuff®)**	Both interventions consisted three sessions of 10 min each followed by a 10 min recovery period.	**Physiological** – tendon microcirculation
Muraoka et al. (2008)	Experimental study	**Cryotherapy (cold water immersion)**	Immersion at 5–8 °C for 60 min (1 application)	**Mechanical** – stiffness
Alegre et al. (2016)	Experimental study	**Cryotherapy**	Application for 30 min.	**Mechanical** – stiffness
Dupuis et al. (2018)	RCT	**Cryotherapy *vs.* Gradual Loading Exercise**	Cryotherapy Group: Ice pack application three times per day for 14 days. Participants were also instructed to maintain relative rest and to avoid painful activities during the intervention period. Gradual Loading Exercise Group: Isometric exercises with progressive loading over a 14-day period. Intensity ranged from 50 % to 75 % of maximal voluntary contraction, with 3–4 repetitions per session and contractions held for 20–30 s. Exercises were performed three times per day for 14 days. Note: Both groups were instructed to perform 5 repetitions of active, gentle, slow, and pain-free shoulder elevation movements in front of a mirror, in three planes.	**Clinical (**pain and function), **Biomechanical** (strength), and **Physiological** (inflammation assessed via ultrasound by measuring the acromiohumeral distance).
Romero-Morales et al. (2019)	RCT	**Exercises + Cryotherapy (cold water immersion) *vs.* Exercises + vibration platform**	Exercises + vibration platform: once per day. Exercises + Cryotherapy (cold water immersion): Immersion of the affected limb in 8 °C water for 17 min, followed by the same therapeutic exercises performed by the other group. Performed once daily for 12 weeks.	**Physiological** – tendon thickness measured by ultrasound.
Rayjade et al. (2020)	quasi- RCT	**Cryotherapy + therapeutic ultrasound *vs.* Therapeutic ultrasound**	Cryotherapy + therapeutic ultrasound group: Ice was applied for 20 min every 4 h, combined with therapeutic ultrasound (7 min–2:8 duty cycle – 1.5 W/cm^2). Therapeutic ultrasound group: 7 min–2:8 duty cycle – 1.5 W/cm^2. Treatment duration: 2 weeks.	**Clinical** (pain and function)
Raja, R. and Huddar, V. (2021)	RCT	**Cryotherapy + exercise *vs.* Therapeutic Ultrasound**	Cryotherapy + exercise: Ice was applied for 20 min, followed by 5–7 min of active shoulder exercises. This was followed by an additional 5-min. ice application and another identical set of active exercises. Therapeutic Ultrasound: Pulsed ultrasound therapy was applied 1 MHz frequency, 0.8 W/cm^2 intensity, and a 1:1 duty cycle, for a duration of 8 min The protocol was performed five times per week for three weeks.	**Clinical** (pain) and **Biomechanical** (strength)
S. Basu et al. (2022)	RCT	**Cryotherapy + exercises *vs.* Postural Taping + Exercises**	Cryotherapy + Exercises: Application of ice for 15 min, followed by the same exercise protocol. Postural Taping + Exercises: Application of postural taping combined with squat and lunge exercises. Exercises were performed in 3 sets of 15 repetitions each. Both groups received treatment for 7 sessions over a period of 3 weeks (15 days).	**Clinical** (pain, function, and ROM)
Durgut et al. (2024)	RCT	**Cryotherapy + Exercises *vs.* Kinesio taping + Exercises**	Cryotherapy + Exercise Group: The first cryotherapy application was supervised; subsequent applications were performed at home or at work. Ice was applied for 20 min, five times per day, for 3 days, combined with the same standardized home exercise program as the Kinesio taping group. Kinesio Taping + Exercises: A single application of Kinesio Taping maintained for 3 days, combined with a standardized home exercise program. Participants performed the exercises three times per day, 10 repetitions per exercise, for a duration of 3 days.	**Clinical** (pain, function, and ROM) and **Biomechanical** (strength)

Abbreviations: RCT, Randomized Controlled Trial; ROM, Range of Motion.

Table 2
Cryotherapy and its isolated or combined use with other therapies in Randomized Controlled Trials (RCTs).

AUTHOR/YEAR	POPULATION	INTERVENTION	COMPARATOR	OUTCOMES	RESULTS
Dupuis et al. (2018)	Rotator cuff tendinopathy	**Cryotherapy** (including rest)	Gradual loading exercises	**Clinical** (pain and function), **Biomechanical** (strength), and **Physiological** (inflammation assessed via ultrasound by measuring the acromiohumeral distance).	No statistically significant differences were found between the groups across any of the three assessed outcomes.
Durgut et al. (2024)	Rotator cuff tendinopathy	**Cryotherapy**	Kinesio taping	**Clinical** (pain, ROM), **Biomechanical** (strength)	Kinesio Taping was more effective across all evaluated outcomes, including pain during activity, functionality, ROM, and grip strength.
Romero-Morales et al. (2019)	Achilles tendinopathy	**Cryotherapy + exercises**	Exercises on a vibration platform	**Physiological** – tendon thickness measured by ultrasound.	Both interventions led to similar adaptations in tendon thickness; however, the study suggests that exercises + vibration platform had a greater impact on tendon remodeling compared to cryotherapy + exercises.
Rayjade et al. (2020)	Biceps tendinopathy	**Cryotherapy + therapeutic ultrasound**	Therapeutic ultrasound	**Clinical** (pain and function),	The combined cryotherapy + therapeutic ultrasound proved to be more effective than ultrasound alone.
Raja and Huddar (2021)	Supraspinatus tendinopathy	**Cryotherapy + Exercises**	Therapeutic ultrasound	**Clinical** (pain), **Biomechanical** (strength)	Cryotherapy + **Exercises** was more effective in both clinical and mechanical outcomes
Basu et al. (2022)	Patellar tendinopathy	**Cryotherapy + exercises**	Postural Taping + exercises	**Clinical** (ROM)	The study concluded that both effective in reducing pain and ROM. However, Postural Taping + exercises showed greater effects than cryotherapy + exercises in enhancing ROM.

Abbreviations: ROM, Range of Motion.

measures.

Dupuis et al. (2018) assessed clinical, mechanical, and physiological outcomes by comparing progressive loading exercises to rest and cryotherapy in patients with rotator cuff tendinopathy. No statistically significant differences were found between groups.

Romero-Morales et al. (2019) evaluated tendon thickness and cross-sectional area by ultrasound in individuals with Achilles tendinopathy. Both intervention groups—one receiving cold-water immersion combined with exercise and the other undergoing vibration platform training—showed significant increases in tendon thickness at rest and during maximal isometric contraction at weeks 4 and 12. However, no statistically significant differences were found between the groups.

Rayjade et al. (2020) reported that the combination of cryotherapy and ultrasound therapy was more effective in reducing pain than ultrasound therapy alone in individuals with biceps tendinopathy. Similarly, Raja and Huddar (2021) found that cryokinetics—combining cold application with exercise—was more effective than ultrasound therapy in improving both pain and muscle strength in patients with supraspinatus tendinopathy. However, the methodological quality of these studies was low, and the certainty of evidence is limited due to the risk of bias identified.

Basu et al. (2022) compared cryotherapy combined with exercise to postural taping plus exercise in patellar tendinopathy. Both interventions reduced pain, with the taping group showing greater improvements in range of motion. Durgut et al. (2024) evaluated cryotherapy versus kinesiotaping in rotator cuff tendinopathy. Both interventions reduced pain, with kinesiotaping producing greater improvements in most outcomes, except for resting and nocturnal pain, where both groups performed similarly.

Among the five studies that assessed clinical outcomes related to pain and function, all included pain as a primary outcome. However, only three studies (Dupuis et al., 2018; Rayjade et al., 2020; Durgut et al., 2024) evaluated both pain and functional outcomes in their analyses.

Regarding the instruments used for pain assessment, the Visual Analogue Scale (VAS) and the Numeric Pain Rating Scale (NPRS) were each applied in two studies (40 %). The Brief Pain Inventory (BPI) was used in only one study (20 %). For the evaluation of functional status, the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) was the most frequently used tool, appearing in 66.7 % of studies that reported functional outcomes (Dupuis et al., 2018; Durgut et al., 2024). The Shoulder Pain and Disability Index (SPADI) was also used in 66.7 % of the studies (Rayjade et al., 2020; Durgut et al., 2024). The Western Ontario Rotator Cuff Index (WORC) appeared in only one study (33.3 %) and was exclusively used by Dupuis et al. (2018).

3.3. *Mechanical and physiological effects of cryotherapy in observational and experimental studies*

The variables analyzed in the studies included in this section encompassed viscoelastic properties, tendon stiffness, and microcirculation. Mechanical outcomes—such as viscoelastic behavior and tendon stiffness—were assessed in three studies. Kubo et al. (2005) investigated the viscoelastic properties of the Achilles tendon following a single cold-water immersion at 5 °C for 30 min. No significant changes were observed. Muraoka et al. (2008) reported a small but statistically significant increase in Achilles tendon stiffness after 60 min of cold-water immersion (5–8 °C), which led to a 6 °C reduction in leg temperature. Alegre et al. (2016) applied ice packs over the patellar tendon for 30 min and observed a significant increase in tendon stiffness following the intervention.

Two studies focused on physiological outcomes, particularly tendon microcirculation. In Knobloch et al. (2006), cryotherapy combined with compression (Cryo/Cuff®) was applied to the Achilles tendon in three 10-min sessions, each followed by a 10-min recovery period. This protocol reduced capillary blood flow, preserved deep tendon oxygenation, and enhanced venous outflow. In a subsequent study by the same group (Knobloch et al., 2007), intermittent cryotherapy (three 10-min cycles) using the KoldBlue® device led to a 71 % reduction in capillary flow, with tissue oxygenation restored within 2 min of rewarming.

Table 3
Studies assessing clinical outcomes: Pain and function.

AUTHOR/ YEAR	DIAGNOSIS	TENDINOPATHY	PROMs for PAIN	PROMs for FUNCTION
Dupuis et al. (2018)	Clinical – Painful arc of motion, positive Neer or Kennedy-Hawkins tests, and pain during resisted isometric external rotation or abduction, or a positive Jobe test. Imaging included MRI. The study did not specify who performed the diagnosis or the level of experience of the assessors.	Rotator cuff tendinopathy	BPI	DASH WORC
Rayjade et al. (2020)	Clinical – (Speed's test); the diagnosis was performed by a certified orthopedic surgeon or physiotherapist. However, no details were provided regarding the experience level of these professionals.	Biceps tendinopathy	VAS	SPADI
Raja, R. and Huddar, V. (2021)	Clinical – Participants were assessed in the physiotherapy department of a tertiary care center, suggesting that the diagnosis was made by physiotherapists or specialist physicians.	Supraspinatus tendinopathy	VAS	It was not conducted
Durgut et al. (2024)	Clinical – Neer test, Speed's test, O'Brien's test, and Jobe test; imaging included magnetic resonance imaging (MRI). Diagnoses were made by orthopedic surgeons.	Rotator cuff tendinopathy	NPRS	DASH e SPADI
S. Basu et al. (2022)	Clinical – patient report, observation, and palpation.	Patellar tendinopathy	NPRS	It was not conducted

Abbreviations: BPI - Brief Pain Inventory; DASH - Disabilities of the Arm, Shoulder and Hand questionnaire; WORC - Western Ontario Rotator Cuff Index; VAS - Visual Analog Scale; NPRS - Numeric Pain Rating Scale; SPADI - Shoulder Pain and Disability Index; Magnetic Resonance Imaging (MRI).

3.4. Methodological quality

The methodological quality of the included studies was assessed using the PEDro Scale (Physiotherapy Evidence Database) (see Table 4). Table 5 presents the seven analyzed studies and their respective PEDro scores. Among them, three studies were considered to be of good quality (scores ranging from 6 to 8), while four studies were classified as having acceptable quality (scores of 4–5). No study was rated as having poor methodological quality (score <4) (Cashin et al., 2020). The most common methodological issues involved the lack of blinding (of participants, therapists, and/or outcome assessors) and deficiencies in the allocation process.

3.5. Risk of Bias

The risk of bias in the included studies was assessed using the Risk of Bias 2 (RoB 2) tool, developed by the Cochrane Collaboration. As shown in Fig. 2, four studies were judged to have a low risk of bias: Dupuis et al. (2018), Romero-Morales et al. (2019), Raja and Huddar (2021), and Durgut et al. (2024). Two studies, Knobloch et al. (2008) and Rayjade et al. (2020), were rated as having some concerns, mainly due to insufficient reporting of allocation concealment and lack of blinding. Finally, Basu et al. (2022) was judged to be at high risk of bias, primarily because of methodological weaknesses in the randomization process, lack of blinding, and reliance on subjective outcomes such as pain perception. Across the included studies, the most frequent sources of bias were inadequate reporting of allocation procedures, absence of blinding of participants and outcome assessors, and the use of self-reported measures, which are more vulnerable to performance and detection bias. While several trials demonstrated robust methodology, methodological limitations in others reduce the overall certainty of the evidence.

4. Discussion

This review primarily evaluated RCTs addressing pain and function in tendinopathy, while also incorporating experimental and observational evidence on mechanical and physiological outcomes to complement clinical interpretation. The findings suggest that cryotherapy may provide short-term pain relief, particularly when combined with other therapeutic modalities such as exercise or ultrasound. However, its structural and long-term effects remain poorly understood, and the methodological limitations of the included studies substantially reduce the certainty of the evidence.

Regarding the primary objective—to evaluate RCTs in patients with tendinopathy, focusing on clinical outcomes such as pain and function—the results were inconsistent. Although some studies reported short-term pain reduction, especially when cryotherapy was combined with exercise (Dupuis et al., 2018) or ultrasound (Rayjade et al., 2020), functional outcomes were rarely assessed and, when measured with validated PROMs (e.g., DASH, SPADI, WORC), the findings were limited and inconsistent. The risk of bias assessment using RoB 2 indicated heterogeneity in study quality. Four RCTs (Dupuis et al., 2018; Romero-Morales et al., 2019; Raja and Huddar, 2021; Durgut et al., 2024) were judged to be at low risk of bias, while two trials (Knobloch et al., 2008; Rayjade et al., 2020) were rated as having some concerns, and one (Basu et al., 2022) as high risk. The most common methodological shortcomings were insufficient allocation concealment, lack of blinding of assessors, and failure to apply intention-to-treat analysis. These weaknesses reduce internal validity and highlight areas that should be prioritized in future RCTs. Similarly, PEDro scores reflected heterogeneity, ranging from 4 to 8. Two trials achieved high quality (≥8), three were moderate (6–7), and the remainder scored low (≤5), failing to meet criteria such as assessor blinding, allocation concealment, and complete follow-up.

These limitations are evident in specific examples. In Dupuis et al. (2018), both groups performed active range-of-motion exercises, which may have contributed to improvements in motor control and pain, potentially masking the isolated effects of cryotherapy. Similarly, Romero-Morales et al. (2019) compared cryotherapy plus exercise with vibration training but did not include an exercise-only group, making it impossible to isolate the effect of cryotherapy. Another recurring limitation was the absence of sham or placebo-controlled groups, as observed in Basu et al. (2022) and Durgut et al. (2024), which are essential to distinguish specific physiological effects from placebo-related responses (Critelli and Neumann, 1984). In addition, follow-up periods were extremely short—only one week in Rayjade et al. (2020) and three days in Durgut et al. (2024)—restricting conclusions about the persistence of effects. Taken together, the RoB 2 and PEDro

Table 4
Mechanical and physiological effects of cryotherapy in observational and experimental studies.

AUTHOR/ YEAR	TYPE OF STUDY	TENDON CONDITION LOCATION	INTERVENTION	DURATION AND FREQUENCY OF THE INTERVENTION	OUTCOME	RESULTS
Kubo et al. (2005)	Experimental study	No injury – Achilles tendon	**Cryotherapy** (cold water immersion)	Leg immersion in 5 °C water for 30 min (1 application)	**Mechanical**: viscoelastic properties – passive stretching	No changes in tendon properties were found after immersion
Knobloch et al. (2006)	Experimental study	No injury – Achilles tendon	**Cryotherapy + compression (Cryo/Cuff®)**	Three 10-min. sessions, each followed by a 10-min. recovery period.	**Physiological** – tendon microcirculation	Cryotherapy combined with compression reduces capillary flow, improves venous drainage, and preserves deep tendon oxygenation.
Knobloch et al. (2007)	Prospective observational cohort study	No injury – Achilles tendon	**Cryotherapy (KoldBlue®)**	Three 10-min. sessions, each followed by a 10-min. recovery period."	**Physiological** – tendon microcirculation	Cryotherapy exerts beneficial microcirculatory effects on the mid-portion of the Achilles tendon.
Muraoka et al. (2008)	Experimental study	No injury – Achilles tendon	**Cryotherapy** (cold water immersion)	Immersion at 5–8 °C for 60 min (1 application)	**Mechanical** – stiffness	They reported a significant, although small, increase in tendon stiffness following leg cooling at −6 °C."
Alegre et al. (2016)	Experimental study	No injury – patellar tendon	**Cryotherapy**	Application for 30 min.	**Mechanical** – stiffness	Significant increase in tendon stiffness

Table 5
PEDro scores of the included studies.

Author/Year	PEDro Scale
Knobloch et al. (2008)	8
Dupuis et al. (2018)	8
Romero-Morales et al. (2019)	5
Rayjade et al. (2020)	4
Raja, R. and Huddar, V. (2021)	5
Basu et al. (2022)	4
Durgut et al. (2024)	7

assessments indicate that the overall certainty of the evidence remains low, as most studies were classified as 'some concerns' or 'high risk' and failed to meet key criteria such as allocation concealment, assessor blinding, and intention-to-treat analysis.

The analysis of studies that applied cryotherapy as a standalone treatment revealed no evidence of meaningful clinical or structural benefit. Although some authors described minor mechanical or microcirculatory changes, these effects were inconsistent and lacked functional relevance. These findings reinforce the interpretation that cryotherapy alone does not exert a significant therapeutic impact on tendinopathy and should be regarded, at most, as an adjunctive modality within multimodal rehabilitation programs. This conclusion is consistent with previous reviews highlighting the limited efficacy of cold exposure when used as a sole therapeutic approach (Bleakley et al., 2004; Kwiecien and McHugh, 2021).

Concerning the secondary objective—experimental and observational studies evaluating mechanical and physiological outcomes—the results provide complementary but limited insights. Some studies reported transient changes in tendon stiffness and viscoelasticity after cold-water immersion or local icing (Muraoka et al., 2008; Alegre et al., 2016). Others observed reductions in capillary blood flow and increases in venous return without compromising deep tendon oxygenation after cryotherapy with compression (Knobloch et al., 2006, 2007). The short-term pain reductions and physiological changes observed in some trials may be explained by transient mechanisms related to local temperature reduction. Cryotherapy decreases nerve conduction velocity, reduces metabolic rate, and limits inflammatory mediator release, which can temporarily attenuate pain perception and local tissue metabolism (Knight et al., 2000; Enwemeka et al., 2002; Bleakley et al., 2004). In addition, the reduction in capillary blood flow and tissue perfusion observed by Knobloch et al. (2006, 2007) may modulate microcirculatory parameters without producing long-term structural adaptations. These physiological effects could facilitate short-term symptom relief or comfort, particularly when combined with exercise, but they are unlikely to induce sustained tendon remodeling. Therefore, the observed improvements likely reflect temporary neuromodulatory and circulatory adjustments rather than lasting mechanical or morphological changes.Although interesting, these findings come from single-session designs with small samples and high methodological heterogeneity, which limit their clinical extrapolation.

Cryotherapy may serve as an adjunctive strategy for short-term pain relief, supporting patient engagement in rehabilitation programs. However, the lack of consistent effects on function, the uncertainty surrounding its structural impact on tendon tissue, and the methodological weaknesses highlighted by the RoB 2 and PEDro assessments prevent definitive recommendations regarding its therapeutic role in tendinopathy management. Future trials should prioritize robust randomization and allocation concealment, include appropriate placebo or sham comparators, ensure blinded outcome assessment, and adopt longer follow-up periods to clarify whether cryotherapy provides benefits beyond transient symptom relief.

This review has some limitations. Due to methodological heterogeneity and variation in outcome measures, a meta-analysis could not be performed. Although cryotherapy shows potential for pain relief, current evidence lacks the methodological robustness required to support its widespread clinical application. Moreover, the structural effects of cryotherapy on tendon tissue remain poorly understood. A recent systematic review by Racinais et al. (2024) highlighted a significant gap in the literature, identifying no human studies that directly examined the

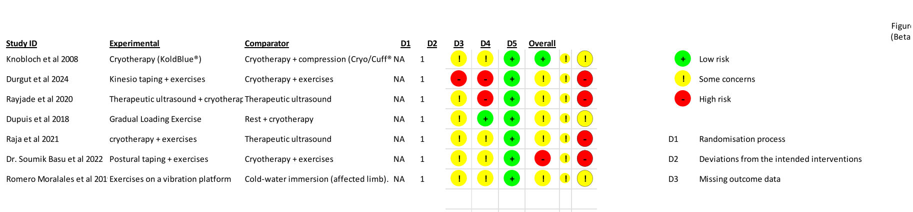

Fig. 2. - Risk of bias 2.

impact of cryotherapy on tendon or ligament healing. The only relevant evidence came from an experimental animal model (Zhang et al., 2014).

5. Conclusion

Although some studies have reported short-term improvements, particularly in pain reduction and microcirculatory parameters, the current body of evidence remains insufficient to support definitive clinical recommendations regarding cryotherapy for tendinopathies. The heterogeneity of interventions, inconsistencies in mechanical outcomes, and methodological limitations undermine the robustness of the findings. Therefore, cryotherapy should not be considered a standalone or standard intervention for tendinopathy management at this stage but may be used as an adjunct in specific contexts. Future high-quality randomized controlled trials are essential to clarify its therapeutic role and to determine whether cryotherapy provides benefits beyond transient symptom relief.

CRediT authorship contribution statement

Tatiana Araújo Lima: Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Thiago Santos Rocha:** Writing – original draft, Validation, Resources, Methodology, Investigation, Formal analysis. **Márcio Almeida Bezerra:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Data curation, Conceptualization. **Rodrigo Ribeiro de Oliveira:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Patient consent statement

This study is a systematic review of previously published data. No new data were collected directly from human participants, and therefore patient consent was not required. All included studies were expected to have obtained ethical approval and informed consent from their participants as stated by the original authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

No funding was received from any public, commercial, or not-for-profit agencies for the preparation of this review.

The authors affirm that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest, in the subject matter or materials discussed in this manuscript.

All authors have approved the final version of the manuscript and agree to be accountable for all aspects of the work.

References

Alegre, L.M., Hasler, M., Wenger, S., Nachbauer, W., Csapo, R., 2016. Does knee joint cooling change in vivo patellar tendon mechanical properties? Eur. J. Appl. Physiol. 116, 1921–1929. https://doi.org/10.1007/s00421-016-3444-5.

Asplund, C.A., Best, T.M., 2013. Achilles tendon disorders. BMJ 346, f1262. https://doi.org/10.1136/bmj.f1262.

Bassett 3rd, F.H., Kirkpatrick, J.S., Engelhardt, D.L., et al., 1992. Cryotherapy induced nerve injury. Am. J. Sports Med. 20, 516–518.

Basu, S., Dugad, S.K., Palekar, T.J., Palekar, P., Deshpande, M., 2022. Comparative study of postural taping and cryotherapy along with exercises in jumper's knee in recreational volleyball players. J. Pharm. Negat. Results 13 (Suppl. 10), 194. https://doi.org/10.47750/pnr.2022.13.S10.194.

Bleakley, C.M., Glasgow, P., MacAuley, D.C., 2012. PRICE needs updating, should we call the POLICE? Br. J. Sports Med. 46, 220–221.

Bleakley, C., McDonough, S., MacAuley, D., 2004. The use of ice in the treatment of acute soft-tissue injury: a systematic review of randomized controlled trials. Am. J. Sports Med. 32 (1), 251–261. https://doi.org/10.1177/0363546503260757.

Bleakley, C.M., O'Connor, S.R., Tully, M.A., et al., 2010. Effect of accelerated rehabilitation on function after ankle sprain: randomised controlled trial. BMJ 340, c1964. https://doi.org/10.1136/bmj.c1964.

Capps, S.G., Brook, M., 2009. Cryotherapy and intermittent pneumatic compression for soft tissue trauma. Athl. Ther. Today 14 (1), 2–4. https://doi.org/10.1123/att.14.1.2.

Critelli, J.W., Neumann, K.F., 1984. The placebo. Conceptual analysis of a construct in transition. Am. Psychol. 39 (1), 32–39. https://doi.org/10.1037//0003-066x.39.1.32.

de Vos, R.J., van der Vlist, A.C., Zwerver, J., et al., 2021. Dutch multidisciplinary guideline on Achilles tendinopathy. Br. J. Sports Med. 55 (20), 1125–1134. https://doi.org/10.1136/bjsports-2020-103867.

Dupuis, F., Barrett, E., Dubé, M.O., et al., 2018. Cryotherapy or gradual reloading exercises in acute presentations of rotator cuff tendinopathy: a randomised controlled trial. BMJ Open Sport Exercise Med. 4 (1), e000477. https://doi.org/10.1136/bmjsem-2018-000477.

Durgut, E., Gurses, H.N., Bilsel, K., et al., 2024. Short-term effects of cold therapy and kinesio taping on pain relief and upper extremity functionality in individuals with Rotator Cuff Tendonitis: a randomized study. Medicina (Kaunas) 60 (8), 1188. https://doi.org/10.3390/medicina60081188.

Enwemeka, C.S., Allen, C., Avila, P., et al., 2002. Soft tissue thermodynamics before, during, and after cold pack therapy. Med. Sci. Sports Exerc. 34 (1), 45–50. https://doi.org/10.1097/00005768-200201000-00008.

Hopkins, C., Rees, J.D., Zwerver, J., et al., 2016. Critical review on the socio-economic impact of tendinopathy. Asia-Pacific Journal of Sports Medicine, Arthroscopy. Rehab. Technol. 4, 9–20.

Knight, K.L., Brucker, J.B., Stoneman, P.D., et al., 2000. Muscle injury management with cryotherapy. Athl. Ther. Today 5, 26–30.

Knobloch, K., Grasemann, R., Jagodzinski, M., et al., 2006. Changes of Achilles midportion tendon microcirculation after repetitive simultaneous cryotherapy and compression using a Cryo/Cuff. Am. J. Sports Med. 34 (12), 1953–1959. https://doi.org/10.1177/0363546506293701.

Knobloch, K., Grasemann, R., Spies, M., Vogt, P.M., 2007. Intermittent KoldBlue cryotherapy of 3x10 min changes mid-portion Achilles tendon microcirculation. Br. J. Sports Med. 41 (6), e4. https://doi.org/10.1136/bjsm.2006.030957.

Knobloch, K., Grasemann, R., Spies, M., Vogt, P.M., 2008. Midportion Achilles tendon microcirculation after intermittent combined cryotherapy and compression compared with cryotherapy alone: a randomized trial. Am. J. Sports Med. 36 (11), 2128–2138. https://doi.org/10.1177/0363546508319313.

Kowalski, G.M., Bruce, C.R., 2014. The regulation of glucose metabolism: implications and considerations for the assessment of glucose homeostasis in rodents. Am. J. Physiol. Endocrinol. Metabol. 307 (10), E859–E871. https://doi.org/10.1152/ajpendo.00165.2014.

Kubo, K., Kanehisa, H., Fukunaga, T., 2005. Effects of cold and hot water immersion on the mechanical properties of human muscle and tendon in vivo. Clin. BioMech. 20 (3), 291–300. https://doi.org/10.1016/j.clinbiomech.2004.11.005.

Kwiecien, S.Y., McHugh, M.P., 2021. The cold truth: the role of cryotherapy in the treatment of injury and recovery from exercise. Eur. J. Appl. Physiol. 121 (8), 2125–2142. https://doi.org/10.1007/s00421-021-04683-8.

Mac Auley, D.C., 2001. Ice therapy: how good is the evidence? Int. J. Sports Med. 22 (5), 379–384. https://doi.org/10.1055/s-2001-15656.

Merrick, M.A., Knight, K.L., Ingersoll, C.D., Potteiger, J.A., 1993. The effects of ice and compression wraps on intramuscular temperatures at various depths. J. Athl. Train. 28 (3), 236–245.

Muraoka, T., Omuro, K., Wakahara, T., et al., 2008. Effects of muscle cooling on the stiffness of the human gastrocnemius muscle in vivo. Cells Tissues Organs 187 (2), 152–160. https://doi.org/10.1159/000109943.

Ouzzani, Mourad, Hammady, Hossam, Fedorowicz, Zbys, Ahmed, Elmagarmid, 2016. Rayyan — a web and mobile app for systematic reviews. Syst. Rev. 5, 210. https://doi.org/10.1186/s13643-016-0384-4.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., et al., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 372 (Mar 29), n71. https://doi.org/10.1136/bmj.n71. PMID: 33782057; PMCID: PMC8005924.

Racinais, S., Dablainville, V., Rousse, Y., et al., 2024. Cryotherapy for treating soft tissue injuries in sport medicine: a critical review. Br. J. Sports Med. 58 (20), 1215–1223. https://doi.org/10.1136/bjsports-2024-108304.

Raja, R., Huddar, V., 2021. Effectiveness of cryokinetics in comparison with ultrasound therapy in acute supraspinatus tendonitis. Biomed. Pharmacol. J. 14 (4), 2249–2254. https://doi.org/10.13005/bpj/2324.

Rayjade, A., Varadharajulu, G., Chintamani, R., Yadav, T., 2020. Effect of ultrasound and cryotherapy in bicipital tendinitis: a randomized clinical trial. Int. J. Res. Pharm. Sci. 11 (3), 4473–4478. https://doi.org/10.26452/ijrps.v11i3.2673.

Romero-Morales, C., Martín-Llantino, P.J., Calvo-Lobo, C., et al., 2019. Ultrasonography effectiveness of vibration vs cryotherapy added to eccentric exercises in Achilles tendinopathy: RCT. Int. Wound J. 16 (2), 542–549. https://doi.org/10.1111/iwj.13074.

Scott, A., Squier, K., Alfredson, H., et al., 2020. ICON 2019: Tendinopathy Symposium Consensus—Clinical terminology. Br. J. Sports Med. 54 (5), 260–262. https://doi.org/10.1136/bjsports-2019-100885.

Shiwa, S.R., Costa, L.O.P., Moser, A.D.L., et al., 2011. PEDro: a base de dados de evidências em fisioterapia. Fisioterapia em Movimento 24 (3), 523–533.
Wang, Z.R., Ni, G.X., 2021. Is it time to put traditional cold therapy in rehabilitation of soft-tissue injuries out to pasture? World J. Clin. Cases 9 (17), 4116–4122. https://doi.org/10.12998/wjcc.v9.i17.4116. Jun 16;PMID: 34141774; PMCID: PMC8173427.
Zhang, J., Pan, T., Wang, J.H., 2014. Cryotherapy suppresses tendon inflammation in an animal model. J. Orthopaedic Transl. 2 (2), 75–81. https://doi.org/10.1016/j.jot.2014.01.001.