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Cryotherapy and Cold Water Applications

This page summarises scientific studies on **cryotherapy** and **cold water applications**, a significant proportion of which involve human subjects. The evidence base is broad but heterogeneous: while controlled studies primarily examine the **musculoskeletal system** and **inflammatory processes**, many areas of application remain methodologically under-supported. The most striking finding is the discrepancy between widespread practice and robust evidence—particularly regarding systemic effects.

1,373

STUDIES IN
TOTAL

761

IN HUMANS

203

OF WHICH
CONTROLLED

22

IN ANIMALS

11

IN THE LAB

Figures from the IHR study database · Last updated 2026-10-04

How to Read This Dossier

ESTABLISHED

measured in humans, with a comparison group

PLAUSIBLE

supported by mechanism, animal studies or observation

HYPOTHESIS

a likely connection that still needs to be tested

Cryotherapy and Cold Water Applications at a Glance

ORIGIN:

Cryotherapy and cold water applications encompass targeted therapeutic cold interventions, such as local measures (ice packs, cold water baths) or systemic procedures (whole-body cryotherapy in cold chambers, cold water immersion). Originating from physical medicine and sports rehabilitation, these methods have been used for decades to alleviate pain, reduce inflammation, and promote regeneration. Historical roots trace back to antiquity, while modern forms utilise controlled temperatures and various application methods.

EVIDENCE BASE:

344 evaluated studies · 42 controlled human trials · 139 observational studies · 19 review articles · 9 animal studies · 1 cell culture study

STRONGEST EVIDENCE:

- Musculoskeletal System Cryotherapy showed a reduction in delayed-onset muscle soreness within 24 hours post-exercise (SMD -0.57; p = 0.0005), though no effects are observed beyond 24 hours. Cold water immersion and local cryotherapy are particularly effective in postoperative rehabilitation (e.g., total knee arthroplasty), where they reduce pain and oedema.
- Inflammatory Processes Local cryotherapy (e.g., ice) lowers proinflammatory cytokines such as IL-6, IL-1 β , and prostaglandin E₂ in synovial fluid in microcrystalline-induced arthritis. Preclinical studies in animal models suggest systemic whole-body cryotherapy (WBC) may increase antioxidant capacity (TRAP) in a dose-dependent manner, particularly in rheumatoid arthritis; these effects have not been confirmed in human trials.
- Postoperative Pain Management Cryotherapy (ice application) significantly reduces acute pain during chest drain removal following coronary artery bypass grafting (p = 0.001), comparable to relaxation therapy. Effects, however, are limited to the immediate period.
- Chronic Pain Syndromes Whole-body cryotherapy (WBC) improves pain (Δ VAS 3.0 vs. 0.3), disease burden (Δ FIQ 32.1 vs. 0.4), and severity (Δ ICAF 13.7 vs. 0.07) in fibromyalgia patients after 4 weeks (p < 0.001), though the study lacked blinding and carries a risk of placebo effects.
- Fatigue WBC at -60°C showed an improvement in IRLS scores (p = 0.009) and quality of life (p = 0.006) in restless legs syndrome after 2 weeks. In multiple sclerosis, WBC reduces fatigue (FSS) and improves functional status (MSIS-29), particularly in high-fatigue subgroups.

LIMITATIONS:

- Systemic effects (e.g., metabolism, cognition) are methodologically poorly supported: small sample sizes, lack of blinding, and short observation periods predominate. Negative or neutral results are less frequently published, leading to publication bias.
- The transferability of mechanistic studies (e.g., inhibition of NF- κ B in animal models) to humans remains unconfirmed. Clinically relevant outcomes, such as functional improvement or long-term trajectories, are rarely investigated.
- Standardised protocols are lacking: temperature, duration, and application method (dry vs. wet) vary widely, complicating direct comparisons. Many studies do not compare cryotherapy with established interventions such as physiotherapy or pharmacological therapy.

CLASSIFICATION:

Controlled human trials show effects of cryotherapy and cold water applications on local pain and inflammation, whereas systemic effects and long-term outcomes remain methodologically understudied.

1. What Cryotherapy and Cold Water Applications Are

Cryotherapy encompasses targeted cold applications to therapeutically influence physiological processes. This includes **localised measures** such as ice packs, cold air, or cold water baths, as well as **systemic applications** like whole-body cryotherapy in cold chambers (cryosaunas) or cold water immersion. These methods originate from physical medicine and sports rehabilitation, where they have been used for decades to alleviate pain, reduce inflammation, and promote recovery. Historically, cold applications date back to antiquity, while modern forms utilise controlled temperatures in the studied contexts.

Key to the Evidence Base is the **diversity of application methods**: Local cryotherapy primarily acts via **vasoconstriction** and **slowed nerve conduction**, whereas systemic applications trigger complex hormonal and metabolic responses—such as the release of **noradrenaline** or **inflammatory mediators**. **Duration, temperature, and application method** (dry vs. wet) vary widely, complicating direct comparisons. Furthermore, **surrogate parameters** such as **interleukin-6** or **pain scales** are often used as primary endpoints, while clinically relevant outcomes like **functional improvement** or **long-term trajectories** are less frequently investigated.

2. What the Studies Show in Detail

The pivotal human studies and key reviews—by application area, including population, duration, preparation, outcome measures, and results as reported in the original publications. Numbers are included only where the study provides them.

Distribution of **controlled human trials** by application area—the numbers are not additive, as a single study may be assigned to multiple areas:

APPLICATION AREA	CONTROLLED STUDIES
Musculoskeletal System	27
Safety and Tolerability	15
Inflammatory Processes	11

APPLICATION AREA	CONTROLLED STUDIES
Fatigue and Stress	10
Oncology	5
Dermatology	4
Cognition and Mental Health	4
Metabolism	4

Further Investigations – Symptomatic Effects in Fibromyalgia and Postoperative Pain

A randomised, open-label crossover study involving 60 fibromyalgia patients (meeting ACR criteria) compared whole-body cryotherapy (WBC) in a Cryosense TCT cabin with a rest period. Participants received either WBC or rest for 2 or 4 weeks, followed by a group switch. Primary endpoints were pain (VAS), disease burden (FIQ), and severity (ICAF). Due to a demonstrated period effect with residual WBC impact, only data from the first sequence were analysed. After 4 weeks, the WBC group showed significantly greater improvements: Δ VAS pain 3.0 vs. 0.3 ($p < 0.001$), Δ FIQ 32.1 vs. 0.4 ($p < 0.001$), and Δ ICAF 13.7 vs. 0.07 ($p < 0.001$). Effects persisted after adjusting for baseline differences. Limitations include the open-label design, which may favour placebo effects, and the lack of participant and assessor blinding ¹.

A randomised, single-blind study involving 80 patients post-coronary artery bypass grafting compared cryotherapy (ice application) with relaxation therapy and a control group for pain reduction during chest drain removal. Cryotherapy consisted of local ice application to the wound area immediately before drain removal. Immediately post-procedure, a significant difference in pain intensity was observed between the treatment groups (cryotherapy and relaxation) and the control group ($p = 0.001$), with no difference between cryotherapy and relaxation therapy. Pain reduction was comparable in both groups, though relaxation therapy was recommended due to its ease of application and lack of side effects. Limitations include the lack of patient blinding and the single application of cryotherapy, precluding conclusions about long-term effects ².

HYPOTHESIS The findings suggest that cryotherapy may be effective for both chronic pain syndromes such as fibromyalgia and acute postoperative pain. The mechanisms may involve modulation of nociceptive signalling pathways and a reduction in local inflammatory mediators. However, long-term data on the sustainability of effects are lacking, particularly for fibromyalgia, as are comparisons with established therapeutic approaches such as pharmacological pain management or physiotherapy.

Musculoskeletal System – Delayed Onset Muscle Soreness, Joint Diseases, and Postoperative Rehabilitation

Cryotherapy was applied within one hour after exertion and included cold water immersion (CWI) or other cold applications. The meta-analysis showed that cryotherapy significantly reduced perceived muscle soreness within 24 hours after exertion (SMD -0.57; 95% CI -0.89 to -0.25; $p = 0.0005$), while the effect was no longer detectable after more than 24 hours ($p = 0.05$). CWI (SMD -0.48; $p = 0.008$) and other cold therapies (SMD -0.68; $p = 0.03$) were effective within 24 hours. Heat therapy also showed significant effects, particularly hot packs (SMD -2.31 within 24 h; $p = 0.03$). A limitation is the heterogeneity of studies regarding cryotherapy application methods and exercise protocols ³.

A randomised study of 30 patients with adhesive capsulitis of the shoulder compared a combination of physiotherapy, joint mobilisation, and whole-body cryotherapy (WBC) with a group receiving only physiotherapy and joint mobilisation. WBC was applied daily for an unspecified duration. Primary endpoints were pain (VAS), active range of motion (ROM), and the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES). After the intervention, the group receiving the combined treatment showed significantly greater improvements in all parameters: VAS ($p < 0.01$), ROM for flexion, abduction, internal and external rotation ($p < 0.01$), and ASES ($p < 0.01$). Both groups improved significantly from baseline, but the effect was more pronounced in the combined treatment group. Limitations include the lack of blinding and the unclear duration of WBC application, which complicates comparability with other studies ⁵.

Ten interventions were investigated, including CWI, hot packs, ice massage, passive recovery, and cryotherapy modalities. Within 24 hours after exertion, hot packs were the most effective for pain relief, followed by contrast water therapy. After 48 hours, a novel cryotherapy modality, followed by hot packs, yielded the best results among the evaluated interventions. Beyond 48 hours, the novel cryotherapy modality was the most effective for outcomes specific to cryotherapy applications. However, as this review included multiple interventions beyond cryotherapy, the findings for cryotherapy alone are limited, and the quality of the included studies restricts the strength of the conclusions ⁶.

Cryotherapy included both continuous cold flow devices and cold packs. The primary endpoint was pain (VAS) on postoperative days (POD) 1, 2, and 3. The cryotherapy group showed significantly lower VAS scores on POD 1 (MD -0.59; $p = 0.04$) and POD 2 (MD -0.84; $p = 0.04$) compared to the control group. Secondary endpoints such as opioid consumption, blood loss, and range of motion showed no consistent differences. Limitations include the heterogeneity of cryotherapy protocols and the lack of standardisation in cold application ⁹.

Both groups received a similar rehabilitation programme with continuous passive motion. The cryotherapy group showed significant improvements in knee flexion, pain reduction (VAS), oedema reduction, and walking ability (10-metre walk test) compared to the control group ($p < 0.05$). The results suggest that the combination of cryotherapy and rehabilitation may accelerate postoperative recovery in these parameters, though the contribution of cryotherapy alone remains unclear, as it was not isolated in this study. Limitations include the lack of blinding and the short follow-up period of two weeks ¹⁰.

A randomised study of 60 participants compared the effects of total cold water immersion (TCWI) with ice massage on recovery from exercise-induced muscle damage. Measurements included serum creatine kinase (CK) levels, maximal strength (1-RM), counter-movement jump (CMJ), and pain (VAS) at five time points (baseline, 2 h, 24 h, 48 h, 72 h). Both groups showed significant improvements, but values normalised more quickly in the TCWI group: CK levels returned to baseline after 72 hours, whereas they remained elevated in the ice massage group. The TCWI group nearly reached baseline values for 1-RM, CMJ, and VAS after 72 hours ($p < 0.001$), suggesting superior recovery in these parameters. Limitations include the lack of blinding and the single application of the intervention ¹³.

HYPOTHESIS The data indicate that cryotherapy may show effects for delayed onset muscle soreness (DOMS), postoperative rehabilitation, and joint diseases, although the effects are time-limited (typically < 48 hours). Combination with active rehabilitation appears to have synergistic effects. However, standardised protocols for optimal application (temperature, duration, frequency) are lacking, and most studies do not compare cryotherapy with other established approaches such as physiotherapy or pharmacological therapy.

Inflammatory Processes – Local and Systemic Effects

Patients were randomised to receive either ice (30 minutes, twice daily) or cold CO₂ (2 minutes, twice daily). Synovial fluid was analysed before and 24 hours after treatment. Ice significantly reduced levels of IL-6, IL-1 β , VEGF, NF- κ B-p65, and prostaglandin E₂ (PG-E₂) in synovial fluid ($p < 0.05$), particularly in microcrystalline arthritis. Cold CO₂ only reduced VEGF levels. In a second phase, the effect of ice on the treated knee was compared with the untreated contralateral knee: PG-E₂ decreased significantly in the treated knee, while it increased in the untreated knee. Limitations include the lack of blinding and the short observation period of 24 hours.

A randomised study of 60 patients with active seropositive rheumatoid arthritis (RA) investigated the effect of WBC on antioxidant capacity. Participants were divided into three groups: WBC at -110°C, WBC at -60°C, or local cryotherapy (three times daily for 7 days). Total plasma antioxidant capacity (TRAP) was measured daily. Baseline TRAP values were significantly lower in the -110°C group (989 μ M/l) than in the local cryotherapy group (1244 μ M/l; $p = 0.006$). After the first treatment, TRAP increased slightly in all groups, with the most pronounced increase in the -110°C group (23.6 μ M/l; $p < 0.05$). The study showed a dose-dependent effect of WBC on antioxidant capacity, but did not assess clinical endpoints such as pain or inflammatory markers ⁴.

A systematic review with meta-analysis of 99 studies examined various recovery techniques, including cryotherapy, and their effect on inflammatory markers after physical exertion. Among the methods assessed, cryotherapy (including massage) was identified as one of several approaches for reducing DOMS and fatigue. Limitations include the heterogeneity of the studies and the lack of differentiation between local and systemic cryotherapy ²⁰.

An observational study of 100 fibromyalgia patients compared the effect of WBC (10 sessions) with a control group without WBC. Both groups maintained their pharmacological therapy. The WBC group showed a significantly greater improvement in quality of life (measured by VAS, SF-36, and Global Health Status) and a reduction in fatigue severity scores (Fatigue Severity Scale) compared to the control group. The study suggests symptomatic relief from WBC, but the lack of blinding and an active control group may favour placebo effects ¹⁹.

HYPOTHESIS Cryotherapy appears to have both local and systemic anti-inflammatory effects, particularly through the reduction of pro-inflammatory cytokines and oxidative stress. The data suggest that WBC may show potential as an adjuvant therapy for chronic inflammatory conditions such as RA or fibromyalgia. However, long-term studies on the sustainability of effects and comparisons with established therapies such as biologics or physiotherapy are still needed.

Fatigue and Stress – Impact on Fatigue and Sleep Quality

A randomised, single-blind study of 35 patients with restless legs syndrome (RLS) investigated the effect of WBC at -60°C, WBC at -10°C, and local cryotherapy at -17°C. Therapy was applied daily for 3 minutes over 2 weeks. The primary endpoint was the IRLS score. Only the -60°C group showed a significant improvement in the IRLS score ($p = 0.009$) and quality of life (RLS-QLI; $p = 0.006$) after 4 weeks. Local cryotherapy improved sleep quality (MOSS; $p = 0.020$) and quality of life (RLS-QLI; $p = 0.014$) but not the IRLS score.

A case-control study of 48 multiple sclerosis (MS) patients (24 with high fatigue, 24 with low fatigue) examined the effect of WBC (10 sessions at -110°C) on fatigue and functional status. Both groups showed significant improvements in fatigue (FSS) and functional status (RMA, MSIS-29), with more pronounced effects in the high-fatigue group (e.g., MSIS-29-PHYS: $p < 0.001$). The study suggests a dose-dependent effect of WBC, but the lack of a control group without WBC limits the strength of the findings ¹⁷.

HYPOTHESIS The data suggest that WBC may improve fatigue and sleep quality in neurological conditions such as RLS or MS. The mechanisms may involve modulation of the autonomic nervous system and a reduction in inflammatory mediators. However, studies with active control groups and longer follow-up periods are needed to assess the sustainability of effects.

Metabolism and Oxidative Stress – Systemic Effects

A systematic review with meta-analysis examined the effect of WBC on lipid metabolism. Seven studies were included, showing a significant reduction in triglycerides after WBC. A sensitivity analysis also revealed significantly lower values for total cholesterol and LDL after excluding individual studies. A meta-regression analysis showed that a lower baseline BMI was associated with greater changes in total cholesterol and LDL during WBC. The results suggest a potential metabolic effect of WBC, but data on clinical endpoints such as cardiovascular events are lacking.

An observational study of 22 MS patients (12 depressive, 10 non-depressive) investigated the effect of WBC (10 sessions) on antioxidant status. Total antioxidant capacity (TAS) was significantly lower in depressive patients than in non-depressive patients ($p < 0.0003$). WBC increased TAS in both groups, with a more pronounced effect in depressive patients ($p < 0.002$ vs. $p < 0.01$). The activities of antioxidant enzymes SOD and CAT remained unchanged. The study provides preliminary evidence of improved oxidative stress markers through WBC in humans, but the lack of a control group without WBC limits the findings, and clinical effects remain to be investigated ¹⁸.

HYPOTHESIS WBC may have systemic effects on metabolism and oxidative stress, particularly through the activation of brown adipose tissue and the modulation of inflammatory mediators. However, these findings are preliminary and require further studies with larger sample sizes and longer follow-up periods to confirm clinically relevant effects.

Overall Picture

The available studies show that cryotherapy in various forms (whole-body cryotherapy, local cold application, cold water immersion) may be effective for a range of indications. The effects showed particular promise for acute and chronic pain conditions (e.g., fibromyalgia, postoperative pain, DOMS), inflammatory processes (e.g., arthritis, rheumatoid arthritis), and the acceleration of rehabilitation after orthopaedic procedures. The mechanisms include a

reduction in pro-inflammatory cytokines (IL-6, IL-1 β , VEGF), modulation of oxidative stress, and improvement of antioxidant capacity. Additionally, there is evidence of positive effects in neurological conditions such as RLS or MS, particularly on fatigue scores and sleep quality in the context of these diseases, though these findings are based on patient-reported outcomes and require further validation.

HYPOTHESIS Despite these promising results, the evidence remains still emerging in many areas. Many controlled studies have small sample sizes, short follow-up periods, and lack blinding, which limits their validity. Additionally, comparisons with established therapeutic approaches (e.g., physiotherapy, pharmacological therapy) or standardised protocols for cryotherapy application (temperature, duration, frequency) are often missing. Data in the fields of metabolism, oxidative stress, and neurological diseases are particularly preliminary and require further research with larger sample sizes and longer follow-up periods.

Methodology of the evidence base

The included studies encompass a broad spectrum of designs, including randomised controlled trials (RCTs), reviews, observational studies, and case-control studies. The duration of interventions varies widely: from single applications (e.g., local cryotherapy for postoperative pain) to multi-week programmes (e.g., whole-body cryotherapy for fibromyalgia or multiple sclerosis). Typical endpoints in controlled studies include pain (VAS, FIQ), inflammatory markers (IL-6, CRP, CK), functional status (ROM, RMA), fatigue (FSS), and quality of life (SF-36, RLS-QLI). However, long-term data on the sustainability of effects, comparisons with active control groups, and standardised cryotherapy protocols are systematically lacking. Furthermore, many controlled studies are not blinded, increasing the risk of placebo effects.

Cryotherapy: Where the evidence ends and practice begins

HYPOTHESIS: The **discrepancy between application and evidence** is particularly pronounced in cryotherapy. While **localised cryotherapy applications** (e.g., ice packs after injuries) are well studied in **controlled trials**, **systemic approaches** such as **whole-body cryotherapy** or **regular cold-water immersion** lack **long-term, placebo-controlled studies**. Most research on systemic effects comes from **observational studies** or **small pilot studies**, which **do not permit causal conclusions**. Even in **frequently cited applications**, such as **fatigue syndromes** or **autoimmune diseases**, assumptions are often based on **surrogate parameters** (e.g., interleukin-6 levels), whose **clinical relevance remains unclear**. What remains to be clarified is whether these surrogate markers translate into meaningful clinical outcomes.

A CENTRAL ISSUE is the **lack of standardisation: temperature ranges, application durations, and frequencies** vary so widely that **meta-analyses** often **cannot derive consistent recommendations**. Additionally, **combination therapies** (e.g., cryotherapy + exercise) are rarely studied in isolation, despite their frequent use in practice. **Safety data** are also **incomplete**: While **localised cryotherapy** is considered **low-risk**, **systemic applications** occasionally report **cardiovascular incidents** or **skin damage**, without the **risk profile** being sufficiently characterised.

3. How Robust the Research Is

Research on cryotherapy focuses on **three key areas**: **observational studies** primarily document **acute physiological responses**, such as skin temperature, blood flow, or subjective pain perception. **Basic research** analyses cellular mechanisms, including the **inhibition of NF- κ B** or **oxidative stress**, while **controlled human studies** almost exclusively examine **localised applications** for **musculoskeletal conditions**. The majority of controlled studies address the **musculoskeletal system**, followed by **safety analyses** and **inflammatory markers**. Systemic effects—such as on **metabolism** or **cognition**—are underrepresented. **Oncology** and **dermatological conditions** remain niche areas.

The **evidence base** varies by application: Controlled studies show **consistent effects** for **local pain conditions** (e.g., **joint osteoarthritis**, **muscle soreness**) and **postoperative rehabilitation** (e.g., **knee arthroplasty**), where cryotherapy applications demonstrate benefits within the studied timeframes. **Systemic applications**, such as whole-body cryotherapy, are **methodologically limited**, with **small sample sizes**, **lack of blinding**, and **short observation periods** predominating in the available trials. Reviews also highlight **publication bias**, as negative or neutral results are less frequently published. The **most-cited mechanistic studies** (e.g., on **anti-inflammatory effects**) often derive from **preclinical models** (animal studies or cell cultures), and their applicability to humans **requires further validation**.

4. Common Claims — and What the Data Support

STATEMENT	EVIDENCE BASE
Cryotherapy for chronic pain	Established: Controlled studies are limited to acute pain conditions (e.g., postoperative pain, muscle soreness). Hypothesis: For chronic pain (e.g., fibromyalgia)

STATEMENT	EVIDENCE BASE
Systemic effects on metabolism or the immune system	Most studies examine short-term markers (e.g., inflammatory parameters). Long-term effects on metabolic diseases or immune function are not established
Cold-water immersion for performance enhancement	While short-term recovery after exercise has been demonstrated in studies, there is no evidence for sustained performance enhancement or prevention of injury
Whole-body cryotherapy for neurological diseases	Individual observational studies suggest subjective improvement in multiple sclerosis . Controlled studies with hard endpoints are still pending.

5. The Most Robust Studies

Ranked by validity, not by prominence. The full evaluation includes significantly more studies; here, only the most reliable are listed.

Controlled Human Studies

- ¹ The effect of cryotherapy on fibromyalgia: a randomised clinical trial carried out in a cryosauna cabin (2018)
- ² Comparison of Ice Packs Application and Relaxation Therapy in Pain Reduction during Chest Tube Removal Following Cardiac Surgery (2014)
- ³ Heat and cold therapy reduce pain in patients with delayed onset muscle soreness: A systematic review and meta-analysis of 32 randomised controlled trials (2021)
- Local ice cryotherapy decreases synovial interleukin 6, interleukin 1β, vascular endothelial growth factor, prostaglandin-E2, and nuclear factor kappa (2019)
- ⁴ The effect of cryotherapy on total antioxidative capacity in patients with active seropositive rheumatoid arthritis (2017)
- ⁵ Effects of whole-body cryotherapy in the management of adhesive capsulitis of the shoulder (2013)
- Thermal and hemodynamic response to whole-body cryostimulation in healthy subjects (2013)
- ⁶ Effect of cold and heat therapies on pain relief in patients with delayed onset muscle soreness: A network meta-analysis (2022)
- ⁷ Whole-body and local cryotherapy in restless legs syndrome: A randomised, single-blind, controlled parallel-group pilot study (2016)
- ⁸ Evaluating safety risks of whole-body cryotherapy/cryostimulation (WBC): A scoping review from an international consortium (2023)
- Photobiomodulation by LED does not alter muscle recovery indicators and presents similar outcomes to cold-water immersion and active recovery (2018)
- A comprehensive review of treatment approaches for cutaneous and genital warts (2023)
- ⁹ Cryotherapy for rehabilitation after total knee arthroplasty: A comprehensive systematic review and meta-analysis (2024)
- ¹⁰ Effects of an early exercise programme with cryotherapy on range of motion, pain, swelling, and gait in patients with total knee arthroplasty: A randomised controlled trial (2024)
- Should athletes return to activity after cryotherapy? (2014)
- ¹¹ Whole-body cryotherapy as a treatment for chronic medical conditions? (2023)
- ¹² Comparison of the effects of cold-water immersion and percussive massage on recovery after exhausting eccentric exercise: A three-arm randomised controlled trial (2024)
- ¹³ Comparison of total cold-water immersion's effects to ice massage on recovery from exercise-induced muscle damage (2022)
- ¹⁴ Effectiveness of home-based conventional exercise and cryotherapy on activities of daily living in patients with knee osteoarthritis: A randomised controlled trial (2023)
- Effects of cold-water immersion on lower extremity joint biomechanics during running (2015)
- Cold exposure increases circulating fibroblast growth factor 21 in the evening in males and females (2024)
- Comparing the efficacy of fluconazole and cryotherapy versus cryotherapy alone in treating cutaneous leishmaniasis: A triple-blind randomised clinical trial (2024)
- ¹⁵ Effect of whole-body cryotherapy versus placebo cryotherapy on joint pain induced by aromatase inhibitors in women with early-stage breast cancer: A randomised controlled trial (2023)
- ¹⁶ Direct effect of local cryotherapy on muscle stimulation, pain, and strength in male office workers with lateral epicondylitis: A non-randomised clinical trial (2022)

6. Summary

ESTABLISHED Cold therapy and cold-water applications are well-supported for **localised pain conditions** (e.g., joint osteoarthritis, delayed onset muscle soreness, postoperative rehabilitation) and **acute inflammatory processes**. Controlled studies demonstrate consistent effects in pain reduction and inflammation suppression, particularly through vasoconstriction and slowed nerve conduction. **Plausible:** Preclinical studies suggest a reduction of pro-inflammatory cytokines such as IL-6 or prostaglandin E₂ in animal models or cell cultures, but these findings have not yet been validated in humans. However, the efficacy is time-limited (typically < 48 hours) and depends on the mode of application. **Hypothesis:** Systemic applications such as whole-body cryotherapy (WBC) show positive effects on antioxidant capacity and fatigue in small studies but remain methodologically less robust.

HYPOTHESIS The data suggest that cold therapy may be effective as an **adjunctive measure** in chronic inflammatory diseases (e.g., rheumatoid arthritis, fibromyalgia) or fatigue syndromes (e.g., multiple sclerosis). Potential mechanisms include the modulation of nociceptive signalling pathways, reduction of oxidative stress, and hormonal responses (e.g., noradrenaline release). **Hypothesis:** Combining cold therapy with active rehabilitation or established therapies (e.g., physiotherapy) may produce synergistic effects. However, long-term data on the sustainability of these effects, particularly for systemic applications, are lacking. Furthermore, it remains unclear whether the observed effects are specifically attributable to cold or mediated by non-specific factors (e.g., placebo, distraction).

Future studies should develop **standardised protocols** (temperature, duration, frequency) to improve comparability. **Long-term studies** with clinically relevant endpoints (e.g., functional improvement, medication reduction) and active control groups (e.g., physiotherapy, pharmacological therapy) are necessary to clarify the sustainability and role of cold therapy. Additionally, **systemic effects** (e.g., on metabolism, cognition) should be investigated in larger, blinded studies. Mechanistic research must validate the translatability of animal and cell models to humans, particularly for complex conditions such as fibromyalgia or multiple sclerosis.

7. Unresolved Questions

- **Dose-response relationship:** Are there optimal temperature and time windows for specific applications?
- **Long-term effects:** What systemic changes occur with regular use over months or years?
- **Placebo effects:** How strongly do expectations influence subjective effects (e.g., pain reduction)?

Frequently Asked Questions

Should cryotherapy be used as a standard treatment for acute sports injuries (e.g., contusions)?

Established: Controlled studies demonstrate **short-term pain reduction** and **oedema inhibition** in **acute soft tissue injuries**. **Hypothesis:** However, the **evidence** is limited to **localised applications** (e.g., ice packs) and **short durations**. **Plausible:** **Systemic cold therapies** (e.g., cold water immersion) have **not been investigated** in this context. A key consideration is **differentiation**: while cold may be beneficial for **acute inflammation**, there are **no data** supporting its use in **chronic conditions** or **structural damage** (e.g., ligament tears).

How safe is whole-body cryotherapy for patients with pre-existing cardiovascular conditions?

Established: Safety data are **limited**: controlled studies typically include **healthy participants** or **young athletes**, while **high-risk patients** (e.g., those with **coronary heart disease**) are **excluded**. **Plausible:** **Observational studies** occasionally report **bradycardia** or **blood pressure spikes**, though the **risk profile** remains inadequately characterised. **Hypothesis:** **Recent reviews** recommend **strict indication criteria** and **medical supervision** for patients with **pre-existing cardiovascular conditions**.

Can cryotherapy influence inflammatory processes in autoimmune diseases (e.g., rheumatoid arthritis)?

A small number of controlled studies show **short-term reductions** in **inflammatory markers** (e.g., **interleukin-6**, **prostaglandin E2**) with **localised cryotherapy**. **Systemic effects** have **not been sufficiently investigated**. Furthermore, **long-term data** on **clinical relevance**—such as whether **changes in markers** correlate with **pain reduction** or **functional improvement**—are lacking. **No study** has yet examined whether cryotherapy can **replace** or **supplement pharmacological treatments**.

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Research, put in context. Every statement leads to the original paper; the decision in the individual case rests with the treating professional.
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