International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

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ARTICLE TITLE	WHOLE-BODY AND PARTIAL-BODY CRYOTHERAPY: A REVIEW OF MECHANISMS, APPLICATIONS, AND SAFETY
DOI	https://doi.org/10.31435/ijitss.4(48).2025.4333
RECEIVED	14 September 2025
ACCEPTED	28 November 2025
PUBLISHED	09 December 2025
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WHOLE-BODY AND PARTIAL-BODY CRYOTHERAPY: A REVIEW OF MECHANISMS, APPLICATIONS, AND SAFETY

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ABSTRACT

Introduction: Cryotherapy, encompassing whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC), has gained increasing attention in sports, medicine, rehabilitation, and wellness for its potential anti-inflammatory, analgesic, and recovery-enhancing effects. Originally developed in Japan in the late 1970s for the treatment of rheumatoid arthritis, WBC has since evolved into a multidisciplinary therapeutic modality with a wide range of clinical and non-clinical applications.
Materials and Methods: A systematic literature search of PubMed and Embase from 2013–2025 was conducted using the terms "cryotherapy," "whole-body cryotherapy," and "cryostimulation."
Results: The evidence suggests that WBC elicits systemic anti-inflammatory effects through modulation of cytokines (e.g., decreased IL-1β, TNF-α, and hsCRP; increased IL-10), enhances antioxidant enzyme activity, and improves markers of oxidative stress. Clinical data further indicate beneficial outcomes in conditions such as rheumatic and osteoarticular diseases, fibromyalgia, multiple sclerosis, mood disorders, chronic pain, and obesity. WBC may also support athletic recovery by reducing muscle soreness and improving performance adaptation. Despite its broad therapeutic potential, contraindications, including cardiovascular, neurological, and cold-related disorders, must be observed. Reported adverse effects are generally mild and transient.
Conclusions: Overall, cryotherapy appears to be a promising adjunctive modality, though further controlled studies are warranted to establish standardised treatment protocols and confirm long-term safety and efficacy.

KEYWORDS

Cryotherapy, Whole-Body Cryotherapy, Partial-Body Cryotherapy, Cryostimulation

CITATION

Aleksander Białoń, Paweł Harbut, Dominika Walczak, Weronika Ewa Nowak, Adrian Kruk, Katarzyna Jakubowska, Aleksandra Dorosz, Igor Gawłowski, Aleksandra Mišta, Lidia Jurczenko. (2025). Whole-Body and Partial-Body Cryotherapy: A Review of Mechanisms, Applications, and Safety. *International Journal of Innovative Technologies in Social Science*, 4(48). doi: 10.31435/ijitss.4(48).2025.4333

1. Introduction

Cryotherapy has recently been gaining attention both amongst athletes wanting to improve their performance and people suffering from inflammatory diseases. The treatment incorporates many fields such as sports, medicine, rehabilitation, and wellness. While there are many cold therapies available, two of them are relatively new: whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC). WBC has its origins in Japan in the late 1970s, where it was initially developed by Dr Toshima Yamaguchi as a treatment for rheumatoid arthritis and other inflammatory conditions. Dr Yamaguchi observed that exposing patients to extremely cold air for brief periods could reduce joint pain and inflammation, which led to further investigation into the therapeutic potential of cold exposure. In the 1980s, WBC spread to Europe, particularly Poland, where it was popularised in rehabilitation and sports medicine settings. Over the past two decades, WBC has evolved past musculoskeletal and rheumatic applications to include accelerating recovery in elite athletes, alleviating mood disorders, and managing oxidative stress. This wide and continuously growing range of applications reflects an increasing interest in the systemic anti-inflammatory, analgesic, and neuroendocrine effects of cryotherapy. Its evolution from a niche medical intervention to a widely used wellness and sports recovery modality illustrates both the adaptability of cryotherapy techniques and the increasing scientific exploration of cold-induced hormetic responses.

The purpose of this review is to provide a thorough description and a comparison of Whole-Body and Partial-Body Cryotherapy, as well as to explore their therapeutic effects on patients. We will analyse the possible applications of cryotherapy and study its physiological mechanisms, closing the paper with a discussion of contraindications and potential adverse effects.

2. Methodology:

The primary method adopted for this paper is literature review. The materials taken into account encompass the research articles published in PubMed and Embase. The inquiry was limited to reviewing the literature published between 2013 and 2025. Such a limitation on the material was put in place in order to provide an analysis of only the most recent findings. The keywords used in the search were: “cryotherapy”, “whole-body cryotherapy”, and “cryostimulation”. The early investigation revealed a set of 44 research papers. Following a thorough review, the corpus was restricted to 30 articles most suited for further analysis were selected. The final choice of research papers depended on whether they contained direct and thorough information on the cryotherapeutic procedures as well as their long- and short-term effects on the patients. The 14 discarded articles did not meet the predefined criteria, and so their contents did not contribute to this review.

3. Results

3.1. Description of WBC

WBC is performed in a large device that most often consists of two chambers. These are called the anteroom and the main chamber. The purpose of the anteroom is to gradually acclimatise the user to the cold temperature before they enter the main cryochamber. Spending up to a minute in the anteroom helps minimise warm air infiltration as well as prevent frost buildup. Depending on the device, the temperature in the atrium oscillates between -60 °C to -80 °C. After adjusting in the atrium, patients are asked to move to the main chamber, where they spend between 2 to 4 minutes. The temperature of the main chamber is usually between -110°C and -140°C. After the procedure, the patients leave the chamber and are asked to exercise on stationary bikes in order to gradually raise their temperature. They are instructed not to scratch or rub their skin so as not to damage the epithelium.

3.2. Description of PBC

Partial body cryotherapy is conducted in a partial cryochamber called a cryo-sauna. Contrary to WBC, the area of effect excludes both neck and head. The main cooling component is liquid nitrogen instead of an air mixture (which is the cooling component of WBC). The machine is portable, allowing for usage at sporting events or remote locations.

3.3. Safety limitations

Both of the methods described have several safety limitations. In the case of WBC, there is a requirement for an emergency stop button and an emergency exit to always be present and visible in the chamber. In the case of PBC, a health professional needs to monitor for the possible dangers, which include direct contact with nitrogen and the possibility of asphyxia.

3.4. Effects

In addition to its recognised efficacy in alleviating symptoms of rheumatic disorders [1] and chronic osteoarticular diseases [2], whole-body cryotherapy has also demonstrated benefits in the management and rehabilitation of various other conditions, including multiple sclerosis [3], fibromyalgia [4], mood disorders [5, 6], poor sleep quality [7], obesity [8], functional neurological disorders [9], and post-COVID syndrome [10]. Recent research suggests that the therapeutic applications of WBC have expanded beyond its traditional use in musculoskeletal inflammation, with an increasing number of conditions being safely managed through WBC as a complementary therapy [6, 9, 10].

3.5. Reduction in inflammatory biomarkers

A meta-analysis of 11 randomised controlled trials found that whole-body cryotherapy (WBC) significantly lowered serum IL-1β and increased anti-inflammatory IL-10 compared to controls, demonstrating a systemic anti-inflammatory effect [11]. In another pilot cohort study on healthy adults, an increase in the number of sessions of WBC (-110°C exposures) was associated with a reduction in high-sensitivity C-reactive protein (hsCRP) over the course of up to nine months, which suggests durability of effect [12]. One study found that men with obesity (a state of low-grade chronic inflammation) who undergo ten sessions of whole-body cryostimulation show significantly reduced levels of tumour necrosis factor-α (TNF-α) and increased IL-10 [13]. In patients with Ankylosing spondylitis, the combination of whole-body cryotherapy and exercise has shown synergistic anti-inflammatory benefits. In a controlled clinical study, participants underwent a series of WBC sessions at approximately -110°C for 2–3 minutes daily, followed immediately by structured physical

exercise. Compared to exercise alone, the combined intervention produced significantly greater reductions in several key inflammatory and endothelial biomarkers, including high-sensitivity C-reactive protein (hsCRP), soluble P-selectin (sP-selectin), and soluble vascular cell adhesion molecule-1 (sVCAM-1). Patients also reported reductions in pain intensity and stiffness, which indicates that the benefits of WBC may extend beyond systemic inflammation to functional outcomes [14]. These findings collectively support the idea that cryotherapy can modulate inflammation by down-regulating pro-inflammatory cytokines and up-regulating anti-inflammatory pathways.

3.6. Antioxidant defences

Repeated whole-body cryotherapy exposures appear to enhance the body's antioxidant defences while reducing oxidative damage. For instance, a study conducted on young and older men demonstrated that after undergoing 24 WBC sessions at -130°C, there appears to be a significant increase in antioxidant enzyme activities, such as superoxide dismutase, catalase, and glutathione peroxidase (GPx), as well as higher levels of the stress-response regulators Sirt1 and Sirt3, which suggests activation of adaptive redox pathways [15]. Similarly, Lubkowska et al. (2024) reported that after 20 sessions of WBC, men exhibited increased catalase activity while women showed enhanced superoxide dismutase activity, leading the authors to conclude that cryotherapy "improves the body's antioxidant capacity" and may serve as a supportive therapy in conditions linked to oxidative stress [16]. Another investigation found that combined WBC and kinesitherapy significantly improved endothelial function, reduced lipid peroxidation, and enhanced total antioxidant capacity in healthy participants, demonstrating that cold exposure paired with exercise can synergistically strengthen redox homeostasis [17].

3.7. Rheumatic diseases

WBC has been found to alleviate pain in many rheumatic diseases, such as rheumatoid arthritis (RA) [18], ankylosing spondylitis (AS), and fibromyalgia.

RA is a chronic inflammatory autoimmune disease affecting up to 1% of the general population [19]. The disease causes synovitis and, eventually, leads to joint degeneration. RA involves inflammation of many joints, most notably small joints of the hands, knees, ankles, elbows, shoulders, metatarsophalangeal joints, the cervical spine, and the temporomandibular joints [20]. Since many joints are affected, whole-body cryotherapy (WBC) shows promise as an adjuvant treatment in addition to pharmacological treatment. One study analysed the effect of WBC on a total of 56 RA patients [18]. The results displayed a significant difference in baseline-adjusted pain in relation to the control group and a clinically significant improvement in pain when comparing baseline to discharge values. After a 12-week period, the beneficial effects persisted, both in pain perception and in functional capacity. Furthermore, disease activity was significantly reduced in relation to the baseline. In addition, different cytokine levels were detectable in the intervention group both after the procedure and at the 12-week follow-up, which could explain the therapeutic effects of WBC on RA patients.

Ankylosing spondylitis (AS) is a type of spondyloarthropathy characterised as a chronic inflammatory rheumatic disease, whose etiopathogenesis is based on the overactivation of macrophages. The disease leads to the degeneration of the spine and sacroiliac joints, which undergo fibrosis and calcification, resulting in loss of flexibility and pain. AS results in decreased quality of life and limited physical functions due to ossification of the spine.[21] A relatively new physiotherapeutic method for AS consists of whole-body cryotherapy with subsequent kinesiotherapy. A study has been conducted to measure the changes in inflammatory parameters, oxidative stress, and lipid profile in patients with AS [14]. Results show that the AS patients who underwent a ten-day-long cycle of WBC procedures with subsequent kinesiotherapy had significantly decreased levels of hsCRP and serum ceruloplasmin. The level of soluble intercellular adhesion molecule-1 (sICAM-1) showed a decreasing trend in the WBC group; however, the level of IL-6 did not change significantly. This data shows the potential of WBC as an adjuvant treatment in AS.

Fibromyalgia (FM) is another rheumatoid disease whose symptoms could be treated with WBC. FM is described as a chronic generalized musculoskeletal pain, hyperalgesia, and allodynia. Other symptoms include fatigue, sleep deprivation, anxiety, paresthesia, stiffness of joints, headache, difficulty concentrating, and memory impairment [22]. Therapeutic options are limited; therefore, patients seek help in alternative therapies such as acupuncture, biofeedback, chiropractic sessions, hypnosis, and more. A recent clinical trial has shown a significant improvement in patients undergoing WBC concerning pain, impact of disease, and severity of symptomatology, possibly through reduction of oxidants levels, reducing muscular damage, and accelerating recovery. Cryotherapy takes part in the activation of neuroendocrine and metabolic functions and could alleviate stress in those patients [23].

3.8. Depression

Emerging research suggests that whole-body cryotherapy may provide beneficial effects as an adjunctive treatment for depression. Clinical studies indicate that exposure to extremely cold temperatures can lead to significant reductions in depressive symptoms. For instance, a randomised controlled trial involving 92 adults with depressive episodes reported that participants receiving ten WBC sessions reported greater improvements in the Hamilton Depression Rating Scale (HDRS-17) and Beck Depression Inventory-II (BDI-II) scores compared with a control group exposed to milder cold conditions [24]. Furthermore, a systematic review and a meta-analysis of ten studies found a large overall effect of cryotherapy on mental health outcomes and a moderate-to-large effect on depressive symptoms, suggesting meaningful clinical potential [25]. Although the mechanisms of alleviating depressive symptoms are not fully understood, some potential explanations include modulation of inflammatory cytokines, oxidative stress reduction, and increased endorphin and norepinephrine release during cold exposure.

3.9. Injury treatment

A study by Haq et al. (2022) found that two weekly WBC sessions improved strength and endurance adaptations during a six-week training program, suggesting that WBC may facilitate recovery and performance enhancement in athletes [26]. Additionally, a study by Salas-Fraire et al. (2023) demonstrated that WBC effectively reduced pain and disability in individuals with chronic low back pain, highlighting its therapeutic potential beyond athletic applications [27].

3.10 Obesity

WBC may serve as a useful adjunctive therapy for reducing fat mass and abdominal obesity, and for mitigating the chronic low-grade inflammation that characterises obesity. The cryogenic stimulus appears to induce anti-inflammatory and antioxidant responses, with potential favourable changes in adipokines, such as increased irisin, and reductions in markers of oxidative stress and adiposity. Although the data are still limited and only a small number of studies with varying protocols exist, it appears that WBC protocols may help reduce visceral fat accumulation and body mass using mechanisms somewhat analogous to those of exercise, particularly when applied in repeated sessions and in individuals with higher fat mass [8].

The range of positive effects of WBC is visually juxtaposed in Figure 1.

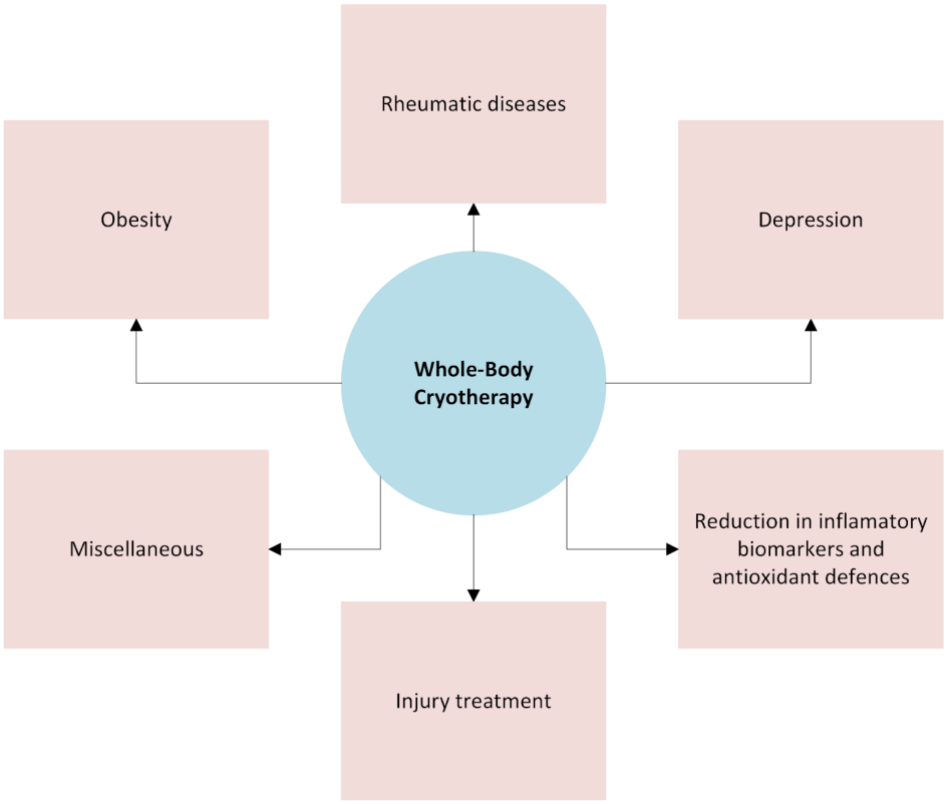

Fig. 1.

3.11. Contraindications and adverse effects

While WBC is generally considered a safe procedure, there are important contraindications to take into consideration before administering this form of treatment. These could be divided into two categories: temporary and permanent. The contraindications are presented in Table 1.

Table 1.

Cryotherapy contraindications	
Temporary	**Permanent**
Ongoing infection	Cardiovascular diseases (ischaemic heart disease, decompensated heart failure, uncontrolled arrhythmia, and others),
Hypertension or symptomatic hypotension	Endocrinological diseases (uncontrolled thyroid diseases, uncontrolled type 1 and type 2 Diabetes)
Fever	Cold-related immunological diseases
Anaemia with Hb ≤ 8,0 mg/dl	Organ insufficiency: acute and chronic renal insufficiency, severe asthma, severe chronic respiratory insufficiency
Pregnancy	Active pulmonary tuberculosis,
Claustrophobia	Invasive cancer
	Neurological diseases (neuropathies of the sympathetic nervous system, chronic migraine, polyneuropathies, recent stroke (<12 months), epilepsy/seizures, certain mental conditions)
	Purulent/gangrenous skin changes
	Glaucoma
	Being over 80 years old [28].

WBC is associated with relatively rare, mostly minor and transient adverse effects. The list of adverse effects is limited, which partially explains its growing popularity. The most commonly described adverse effects include skin reactions (rash, itching, tingling, possible burns/frostbite), sensory/neurological (numbness, tingling, headache, dizziness), cardiovascular/vascular responses (blood pressure changes, vasoconstriction), and general discomfort (fatigue, shivering) [29].

Conclusions

Whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC) represent innovative, non-invasive interventions that capitalise on cold-induced physiological responses to modulate inflammation, oxidative stress, and recovery processes. Current evidence indicates that WBC, in particular, offers measurable benefits across diverse clinical and athletic populations, supporting its role as a complementary therapy in managing inflammatory, metabolic, and mood-related conditions. Repeated exposures appear to strengthen antioxidant defences, enhance physical rehabilitation, and contribute to improved well-being. Nevertheless, the variability in treatment protocols, exposure times, and temperatures among studies underscores the need for standardisation to ensure safety and reproducibility of results. Although generally well tolerated, strict adherence to contraindications and safety guidelines remains essential to minimise potential risks. Future research should focus on elucidating dose-response relationships, optimising session parameters, and exploring synergistic effects with exercise and pharmacological treatments. With appropriate clinical oversight, cryotherapy holds considerable promise as an adjunctive tool in modern rehabilitation and performance medicine.

Disclosure

Author's contribution

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All authors have read and agreed with the published version of the manuscript.

Financing statement: This research received no external funding.
Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Not applicable
Data Availability Statement: Statement not applicable
Conflict of interest statement: The authors declare no conflict of interest.
Declaration of the use of generative AI and AI-assisted technologies in the writing process: In preparing this work, the authors used ChatGPT for the purpose of language improvement and readability and text formatting, verification of bibliographic styles. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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