

## ORIGINAL REPORT

### WHOLE-BODY CRYOSTIMULATION: A REHABILITATION BOOSTER

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**A growing body of work suggests that whole-body cryostimulation (WBC) could play a role as a promising adjuvant therapy in various conditions of rehabilitation interest. In fact, WBC is currently being used to relieve symptoms in rheumatoid arthritis, fibromyalgia, ankylosing spondylitis, depression and anxiety, multiple sclerosis, sleep disturbances, muscle soreness after strenuous physical exercise, post-Covid syndrome and obesity. WBC is not only a symptomatic physical therapy but rather represents an “adaptation therapy” because of the repeated shock-like cryogenic cold stimulus over the entire body surface that induces reactions in the autonomic, endocrine, circulatory, neuromuscular and immunological systems, resulting in an adaptation that contributes to the restoration of the homeostatic state. Therefore, based on the existing evidence, WBC can be described as follows:**

- a “training method” for the autonomic nervous system;
- a novel anti-inflammatory and antioxidant treatment;
- a treatment with beneficial effects on body composition and adipose tissue.

**In our opinion, the powerful effects of thermal stress on the physiological responses of the human body present unique features that could potentially be exploited to boost rehabilitation outcomes in various conditions. Therefore, we believe it is important to highlight the potential use of WBC for medical use and emphasize its relevance in the field of rehabilitation with the aim of stimulating scientific studies on the efficacy of WBC as an adjuvant treatment in various conditions of rehabilitation interest.**

#### LAY ABSTRACT

A growing body of work suggests that whole-body cryostimulation (WBC) could play a role as a promising adjuvant therapy in various conditions of rehabilitation interest, as it can act as

- a “training method” for the autonomic nervous system;
- a novel anti-inflammatory and antioxidant treatment;
- a treatment with beneficial effects on body composition and adipose tissue.

Therefore, we want to highlight the potential use of WBC for medical use and its relevance in the field of rehabilitation with the aim of stimulating scientific studies on the efficacy of WBC as an adjuvant treatment in various conditions of rehabilitation interest.

*Key words:* Whole-body Cryostimulation; Rehabilitation; Low-grade inflammation; Oxidative stress; Cryotherapy.

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About 40 years have elapsed since the first successful exposure of the entire body of rheumatoid arthritis patients to extreme cold for a short period of time (2–3 min at temperatures ranging from  $-110^{\circ}\text{C}$  to  $-140^{\circ}\text{C}$ ). Since then, whole-body cryostimulation (WBC) has

found widespread use in sports medicine. This trend was a reflection of the scientific evidence gathered mainly in this specific literature. However, with the growing knowledge of WBC’s mechanisms of action, related effects and advances in technology that can nowadays tame the thermal stress by providing a controlled and homogeneous “dose of cold” over the patient’s body surface, the spectrum of diseases that can be effectively treated using WBC has expanded considerably. WBC is currently being used to relieve symptoms in rheumatoid arthritis (1), fibromyalgia (1–3), ankylosing spondylitis (4), depression and anxiety (5), multiple sclerosis (6), sleep disturbances (7), muscle soreness after strenuous physical exercise (8), post-Covid syndrome (9, 10) and obesity (11, 12). In our opinion, the powerful effects of thermal stress on the physiological responses of the human body present unique features that could potentially be exploited to boost rehabilitation outcomes in various conditions. WBC is not just a symptomatic physical therapy, but rather represents an “adaptation therapy” because of the repeated shock-like cryogenic cold stimulus over the entire body surface that induces reactions in the autonomic, endocrine, circulatory, neuromuscular and immunological systems, resulting in an adaptation that contributes to the restoration of the homeostatic state (Fig. 1). Based on the existing evidence, WBC can be described as follows:

- a “training method” for the autonomic nervous system (13): the afferent signals from the peripheral receptors converge in the medial preoptic region of the

hypothalamus, from which efferent signals cause reflex cutaneous vasoconstriction, leading to a shift in blood volume towards the core that results in an increased central pressure. This effect is responsible for reducing sympathetic nerve activity through baroreflex activation and shifting autonomic control of heart rate towards parasympathetic dominance. Remote from cold stimulation, an increase in parasympathetic cardiac control occurs (13) even overnight (14). These changes affect fatigue sensation, reduce muscle tension and facilitate post-exercise recovery by reducing the sensations of delayed onset muscle soreness and exercise-induced muscle damage. Lower fatigue sensation is linked to improved mood and sleep quality (14), with a positive impact on symptoms of clinical depression (5).

- a new anti-inflammatory and antioxidant treatment: repeated exposure to WBC decreases the production of pro-inflammatory and oxidative substances, while anti-inflammatory and anti-oxidative compounds are produced in larger amounts (15), thus minimizing secondary tissue damage. Shortly after exposure to cold, vasodilation occurs, allowing for a considerable change in blood flow that can last several hours if followed by exercise, resulting in the removal of metabolic products (16).
- a treatment that delivers beneficial effects on body composition and adipose tissue (12): the anti-inflammatory and anti-oxidative actions improve immunity, antioxidant activity and insulin sensitivity, as well as increase the percentage of brown adipose tissue volume

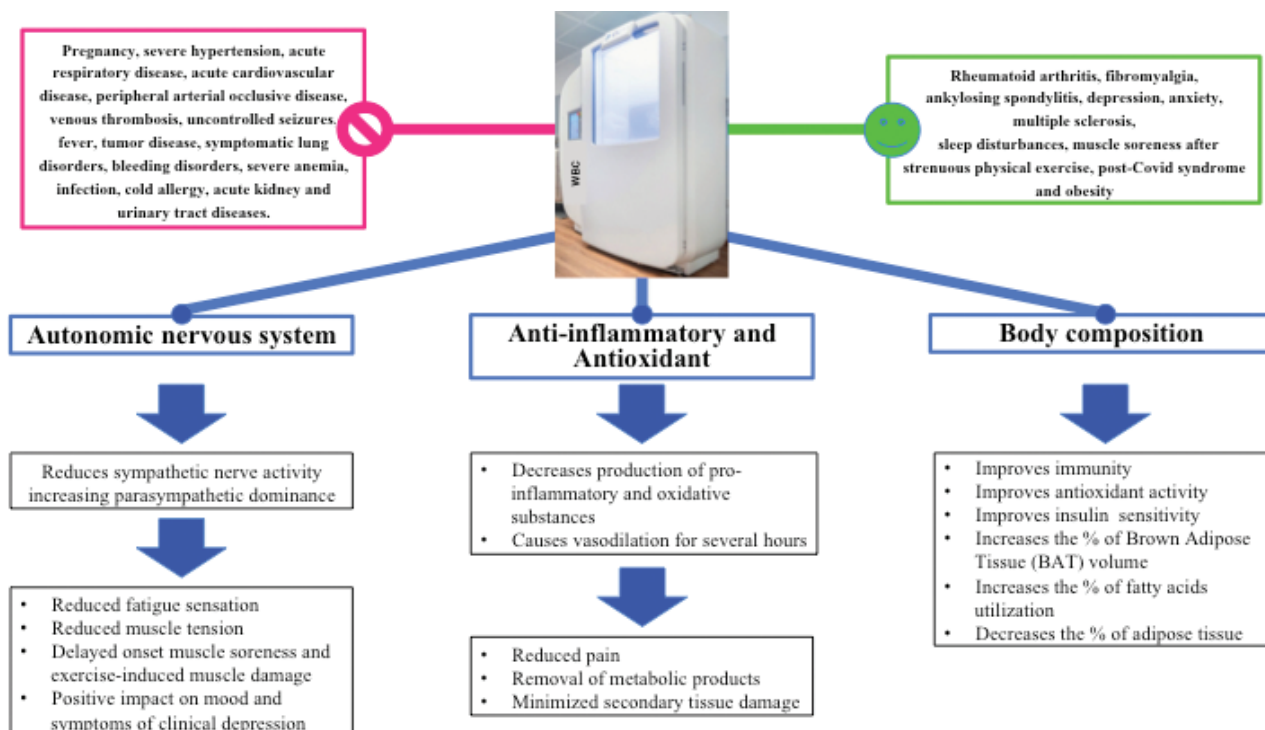


Fig. 1. Working mechanisms of whole-body cryostimulation and its indications and contraindications.

and fatty acid utilization (17), decreasing the percentage of adipose tissue (18).

Impaired autonomic nervous system regulation is frequently observed in patients with cardiovascular diseases (19), subacute stroke (20), Parkinson's disease (21), multiple sclerosis (22), obstructive pulmonary conditions (23) and obesity (11). Autonomic dysfunction is associated with poor functional outcome in patients with subacute stroke and is associated with fatigue in patients with multiple sclerosis. Sympathetic activity in obstructive pulmonary conditions may be affected by recurrent hypoxemia, hypercapnia, increased intrathoracic pressure swings because of airway obstruction, increased respiratory effort, systemic inflammation and beta-sympathomimetics. Treatments aimed at restoring sympathovagal balance towards a reduction in resting sympathetic activity, such as exercise training, muscle stretching and breathing relaxation techniques, should be considered in the rehabilitation of these patients. We now know that WBC can rapidly produce the same effects. Repeated exposures to WBC represent an allostatic stimulus that trains the autonomic nervous system to higher levels of performance. Although the physiological effects of WBC show univocal positive results and are already supported by a sturdy bulk of evidence, clinical studies still suffer from limited sample sizes and methodological issues, so evidence of the clinical benefits of WBC remains preliminary. However, especially because of its rapid anti-inflammatory, exercise-mimicking effects, implementing its use in patients who show poor adherence to rehabilitation protocols because of pain and inflammation may contribute to faster achievement of rehabilitation goals. Its reported effects on mood, sleep and fatigue may contribute to reducing eventual barriers in compliance with rehabilitation programmes in various neurological and frailty conditions. From the safety perspective, absolute contraindications to WBC and guidelines are regularly integrated with the latest findings in the literature. We believe it is about time to highlight to rehabilitation professionals the potential for the medical use of WBC and its relevance in the field of rehabilitation, as a non-medical use of WBC in spas or wellness centres could deliver dangerous scientific shortcuts to the general public. Given the time and resource constraints that we commonly experience in our rehabilitation settings, adjuvant treatments that are expected to boost rehabilitation outcomes should be welcomed in our practice and validated on larger populations. Rather, the current inconclusive, but less and less so, clinical evidence should stimulate scientific studies on the efficacy of WBC as an adjuvant treatment in various conditions of rehabilitation interest.

## CONFLICT OF INTEREST

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