

# IMPACT OF SYSTEMIC CRYOTHERAPY ON PHYSICAL FITNESS

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## ABSTRACT

**Background:** Systemic cryotherapy has broad effects on the human body. These include improved immunity, accelerated tissue regeneration, activation of thermoregulatory mechanisms, analgesic effects, and reduced muscle tension and spasticity without compromising strength.

**Aim of the study:** To evaluate the effect of systemic cryotherapy on physical fitness.

**Material and methods:** The 43 participants (42 – 53 years of age) underwent 10 daily treatments in a nitrogen cryochamber over two consecutive weeks. Each cryochamber treatment lasted for 3 minutes at  $-130^{\circ}\text{C}$ . Physical fitness was tested before and after the cryochamber treatment course using elements of three physical testing methods (a functional movement screen, a TKKF physical fitness test and a general fitness test).

**Results:** After cryotherapy, there was a visible improvement in the first four exercises of the fitness test with fewer participants feeling pain during movement, and more able to perform the exercises correctly or perfectly. For the remaining three exercises, the changes occurred in fewer subjects and to a lesser extent.

**Conclusions:** Systemic cryotherapy was associated with improved physical fitness. It can be used to help increase overall physical fitness as a complementary and supportive process.

**KEYWORDS:** systemic cryotherapy, cryochamber, physical fitness

## BACKGROUND

One of the most dynamically developing fields of modern medicine is physical medicine based on natural treatment methods. An interdisciplinary approach has resulted in various forms of energy being used for both therapeutic and preventive purposes. Among these treatment fields is thermotherapy, which includes cryotherapy. Cryotherapy has been used in therapeutics for over thirty years [1–3], while the practice of cold therapy extends back to ancient times. In the 5<sup>th</sup> century BC, Hippocrates is reported to have surmised that low temperatures, even leading to hypothermia, effectively reduced swelling and bleeding as well as having an anesthetic (analgesic) effect [3,4].

In the first half of the 20<sup>th</sup> century, scientific research on the influence of low temperatures on organism life (cryobiology) developed rapidly. Studies investigating the application of extremely low temperatures to human tissue were undertaken, with the first of these

describing cold as treatment for benign and malignant skin lesions. This gave rise to the treatment strategy of local cryotherapy [5–8].

Systemic cryotherapy is currently used for therapeutic and preventive purposes, and to restore appropriate bodily functions if they have been disturbed. In the human body, it activates generalized physiological and defense reactions, as well as thermoregulatory mechanisms. Extremely low temperatures have analgesic effects, and reduce muscle tension and spasticity without compromising strength [9]. Endocrine effects include altered concentrations of various hormones including adrenocorticotrophic hormone, cortisol, catecholamines (noradrenaline and adrenaline), testosterone, thyrotropin and thyroid hormones [10–12]. Cryogenic temperatures potentiate immunity and can precipitate biochemical cellular reactions including release of growth factors such as epidermal growth factor and growth hormone-releasing peptide 6 [13].

Cryotherapy is widely used in sports as it has a positive effect on the general health and physical fitness of athletes through regenerative processes and biological renewal. It also assists with readiness to undertake further physical exertion [7,10,14,15].

Studies to illustrate and confirm the physiological effects of low temperatures are undertaken regularly. This has promoted systemic cryotherapy as a useful tool for biological renewal for inclusion in cosmetic procedures as well as in physiotherapy when working with patients [11,16–17]. The aim of this study was to evaluate the impact of systemic cryotherapy on physical fitness.

### AIM OF THE STUDY

This study aimed to evaluate the effect of systemic cryotherapy on physical fitness.

### MATERIAL AND METHODS

There were 43 participants (25 men, 18 women) who were 42 – 53 years of age. Inclusion criteria were 40 – 55 years of age and sedentary lifestyle, which was defined as lack of involvement in any form of physical activity or recreation, with daily life limited to professional tasks and family obligations. Exclusion criteria were contraindications to cryochamber treatment (cardiovascular or respiratory diseases, skin changes), and presence of pain in the back, or hip or shoulder joint.

Immediately prior to entering the cryochamber, the blood pressure and heart rate of each participant was measured to confirm a lack of contraindications.

All participants underwent ten daily systemic cryotherapy treatments on Mondays through to Fridays for two consecutive weeks. Each treatment lasted 3 minutes at -130°C.

Before cryochamber treatment, participants performed a test to assess their physical fitness level. This consisted of selected elements of the Functional Movement Screen by Cook et al., TKKF physical fitness for adults by Pilicz and Żmudzki, as well as a general fitness test for junior football players by Talaga. The type and order of the seven exercises in the test was as follows: squat depth, walking over hurdles, lunges, mobility of the shoulder girdle, straightening and bending arms in a front support position, planking supported on fore-arms and straight-leg sit-ups.

The selection criteria for the exercises to verify physical fitness level prioritized safety and physical abilities. The selected exercises were appropriate for the age and lifestyle (no physical activity) of the participants. However, they were also sufficient to evaluate physical fitness level and to obtain knowledge about the general physical condition of the participants. A therapist assessed participant ability to perform each of the first four exercises according to the following: 0 points – participant reported pain on attempting to make a movement, 1 point – participant could not do an exercise, 2 points – participant completed an exercise, but used compensation patterns, and 3 points – participant did the exercise perfectly without compensation patterns.

The subsequent exercises were different, and included the number of repetitions of bending and straightening upper limbs in a front support position within 30 seconds along with the duration of planking on fore-arms and the number of straight-leg sit-ups.

During the two weeks of cryochamber therapy participants maintained their previous lifestyle and did not undertake any physical training or other form of physical activity.

### RESULTS

Tab. 1 shows the comparative results for four kinds of exercises from the general physical fitness test, before and after cryotherapy.

With cryotherapy, there was a decrease in the number of participants (two people) who experienced pain during movement with each exercise test. There was also an increase in the number of participants who could complete an exercise with a compensation pattern, and who could complete an exercise perfectly (shoulder mobility was an exception). Further, the number of participants unable to perform an exercise decreased after cryotherapy.

For the exercise involving straightening and bending of arms in a front support position, the number of participants who did up to 14 repetitions increased from 6 to 13 after cryotherapy. The number of participants who did only ten repetitions decreased from 16 to 10, while the number of participants with the maximum number of repetitions (15) did not change (two people).

For the planking on fore-arms exercise, three participants recorded a time of 21 seconds after cryo-

Table 1. Results of first four exercises of the fitness test, before and after therapy

Exercise/ performance level	Squat depth		Hurdle		Lunge		Shoulder mobility	
	before	after	before	after	before	after	before	after
Pain during movement	5	2	6	4	4	3	2	2
Unable to do the exercise	18	16	7	4	7	1	28	21
Movement with a compensation pattern	14	18	25	28	23	28	13	20
Perfectly done movement	6	7	5	7	9	11	0	0

therapy. This was the longest time recorded, with no participants attaining this good a result prior to cryotherapy. A further three participants maintained the position for up to 19 seconds after cryotherapy. Two individuals from the weakest group improved their result from 11 to 15 seconds.

During the straight-leg sit-up exercise four more people completed eight repetitions after cryotherapy, in comparison to the situation before the therapy. A further seven people did seven repetitions. After cryotherapy, the smallest number of repetitions in this exercise increased from three to five.

## DISCUSSION

Systemic cryotherapy is one of the treatment methods used for various locomotor system diseases such as degenerative changes of the spine, Ankylosing Spondylitis, painful shoulder syndrome, osteoporosis and psoriatic arthritis [14,16,18]. It has an analgesic effect, reduces muscle tension, improves tissue nourishment and increases joint mobility. Obtaining these therapeutic results positively affects patient wellbeing, increasing willingness to undertake recommendations in the field of kinesiotherapy [14,16–18]. Cryochamber treatments contribute to biological renewal for athletes across a range of sporting disciplines. Application of low temperatures shortens the period for muscle regeneration, delays onset of muscle soreness, reduces athlete fatigue, accelerates repair processes and improves effort tolerance [6,7,11,15,18]. These scientific reports that confirm the multifaceted nature and effectiveness of systemic cryotherapy motivate its broader application. We evaluated the impact of cryochamber treatments on general physical fitness in healthy sedentary people, and determined that physical fitness improved as assessed by our study methods. Overall, an increase in the number of repetitions and an improvement in exercise quality were observed. The participants did certain movements better and more precisely, and were able to maintain specific positions for a longer time demonstrating durability. However, substantial changes

were observed only in the case of simple exercises, which utilized movements similar to those undertaken daily e.g. shoulder functioning or a squat. The more difficult exercises done in a front support position or using abdominal muscles had considerably poorer results.

Our results confirm that systemic cryotherapy positively affects general physical fitness and therefore functioning of the human body. However, it cannot replace or equal routine physical activity. During training aimed at increasing general fitness, cryotherapy can be used adjunctively to support the process, but should not be a dominating method. This confirms that the basis of fitness is physical activity and when planning a training session for sedentary adults, it is recommended to include exercises that strengthen the abdominal muscles to correct and stabilize proper posture, and to increase the range of shoulder and hip girdle mobility. We were unable to compare our results to other studies, as there appeared to be no published literature of a similar nature. Most often, general fitness tests are used in young and healthy people who are involved in a physical activity recreationally. In such a context, they constitute a tool to determine current fitness level and as a basis to plan a training session to increase fitness. Fitness tests are also used during entrance examinations at sports universities to select candidates for particular Physical Education courses or physiotherapy [19]. Application of these tests to people of various ages who are not involved in sports or are not physically active allows for illustrative presentation of the participants' physical fitness level. Improved self-awareness enables actions to be undertaken to change and improve general fitness and mobility.

## CONCLUSIONS

The conducted study suggests that systemic cryotherapy benefits physical fitness, but is insufficient to be used as the only method of increasing general fitness. Therefore, cryotherapy should be considered a supplementary method to support physical fitness.

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