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The impact of different recovery approaches on adaptation in physically trained and untrained individuals

Submission date
17/06/2025

Recruitment status
Recruiting

Registration date
23/06/2025

Overall study status
Ongoing

Last Edited
23/06/2025

Condition category
Other

[X] Prospectively registered
[X] Protocol
[_] Statistical analysis plan
[_] Results
[_] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
This study is looking at how different recovery methods affect the body after physical activity. Researchers want to understand how techniques like cold compression, contrast therapy, blood flow restriction, and others help with muscle recovery, reduce fatigue, and support healing. The goal is to find out which methods work best for improving performance and preventing injuries in active people.

Who can participate?
Adults aged 18 to 45 who are physically active—either amateur or professional athletes—can take part. Participants must be in good health and have no medical issues that would prevent them from exercising.

What does the study involve?
Participants will be randomly placed into one of several groups, each using a different recovery method, or into a control group. Depending on the group, the recovery program will last either 2 weeks, 8 weeks, or 6 months. The study will measure things like muscle strength, inflammation, and how participants feel during recovery. All procedures are safe and supervised.

What are the possible benefits and risks of participating?
Participants may benefit from improved recovery and reduced risk of injury. The risks are very low and may include mild, temporary discomfort from the recovery techniques used.

Where is the study run from?
The study is being carried out at CM Provita in Żory, Poland, with help from local sports clubs and training centers in southern Poland.

When is the study starting and how long is it expected to run for?
January 2025 to October 2026

Who is funding the study?
Investigator initiated and funded

Who is the main contact?
Dr Robert Trybulski, rtrybulski.provita@gmail.com

Contact information

Type(s)
Public, Scientific, Principal Investigator

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Additional identifiers

EudraCT/CTIS number
Nil known

IRAS number

ClinicalTrials.gov number
Nil known

Secondary identifying numbers
Nil known

Study information

Scientific Title
Assessment of adaptive effects of diversified recovery strategies among individuals with different levels of motor preparation

Acronym
ARM

Study objectives

1. Participants undergoing recovery interventions (Game Ready, IPC, or contrast therapy) will show significantly greater improvements in biomechanical parameters compared to the control group.
2. The effects of recovery strategies will differ depending on the participant's level of motor fitness, with professional athletes demonstrating more pronounced adaptations.
3. Ischemic preconditioning (IPC) will result in higher perfusion and faster recovery than cold compression or contrast therapy.
4. Participants receiving recovery interventions will report lower subjective fatigue and pain compared to the control group.
5. There will be significant differences in the levels of inflammatory and muscle damage biomarkers (e.g., CK, IL-6, CRP) between intervention and control groups over time.
6. Contrast therapy will be more effective in improving tissue elasticity and muscle stiffness compared to cold compression and ischemic preconditioning.
7. Recovery interventions will reduce the risk of performance decline during the training cycle compared to no intervention.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 11/06/2025, Ethics Committee for Scientific Research of Physiotherapists at the Polish Physiotherapy Association (ul. Zygmunta Modzelewskiego 37/U8, Warszawa, 02-679, Poland; +48 22 840 18 73; biuro@fizjoterapeuci.org), ref: RESOLUTION No. 1/06/2025 of 11 June 2025

Study design
Interventional randomized controlled trial

Primary study design
Interventional

Secondary study design
Randomised controlled trial

Study setting(s)
Fitness/sport facility, Hospital, Other therapist office, University/medical school/dental school, Workplace

Study type(s)
Prevention, Treatment, Efficacy

Participant information sheet

Health condition(s) or problem(s) studied
Physical recovery

Interventions
Study Design Description (English Version)
Interventional, randomized controlled trial (RCT) designed to evaluate the adaptive effects of

various recovery strategies in individuals with differing levels of motor fitness. The study is prospective and includes both parallel-group and crossover components depending on the intervention duration and subgroup allocation.

Study Type:
Interventional study (clinical trial)

Randomized Controlled Trial (RCT)

Partially crossover in selected phases to minimize inter-subject variability and increase statistical power.

Multicenter setting with standardized protocols implemented across different sports clubs and rehabilitation centers.

Randomization:
Participants are randomly assigned to one of four groups using a computer-generated sequence with block randomization (1:1:1:1). Stratification is applied based on age, gender, and motor preparation level (amateur vs. professional), ensuring balanced distribution across groups.

Study Groups:
GR-C: Cold compression therapy (Game Ready system)

GR-IPC: Ischemic preconditioning (IPC)

GR-KT: Contrast therapy (alternating cold and heat)

GR-K: Control group (no intervention or sham/placebo)

Blinding (Masking):
The study applies single-blind masking, where participants are blinded to the specific nature of the intervention, especially in the case of sham procedures.

Assessors and data analysts are also blinded to group assignments to reduce assessment bias (i. e., assessor-blinded).

Due to the nature of physical interventions, full double-blinding is not feasible, but steps are taken to ensure procedural uniformity and minimize expectancy effects.

Crossover Design:
For selected subgroups and where ethically and logistically feasible, a crossover approach is used. After a washout period, participants may receive a second type of intervention, allowing within-subject comparison and better evaluation of intervention-specific effects.

Summary:
This RCT investigates short-term (2-week), medium-term (8-32 week), and long-term (6-month) outcomes related to recovery strategies. The study incorporates objective physiological, biomechanical, and biochemical measures, as well as subjective recovery and fatigue scales. The design supports high internal validity while reflecting practical implementation in sports and physiotherapy settings

Intervention Type

Mixed

Primary outcome measure

At baseline, after 2 weeks of intervention, and after 8 weeks. For long-term follow-up groups, we will also conduct measurements at 6 months:
1. Biochemical markers (measured in blood serum):
1.1. Creatine kinase (CK) – measured in U/L; spectrophotometric ELISA; standard laboratory method; Poland, 2023.
1.2. C-reactive protein (CRP) – measured in mg/L; immunoturbidimetric assay; Poland, 2023.
1.3. Lactate dehydrogenase (LDH) – measured in U/L; spectrophotometric assay; Poland, 2023.
1.4. Interleukin-6 (IL-6) – measured in pg/mL; ELISA; Poland, 2023.
1.5. Tumor necrosis factor alpha (TNF-α) – measured in pg/mL; ELISA; Poland, 2023.
1.6. Cortisol – measured in µg/dL; immunoassay; Poland, 2023.
1.7. Testosterone – measured in ng/dL; immunoassay; Poland, 2023.

2. Mechanical and biomechanical measures:
2.1. Muscle tension, stiffness, and elasticity – measured in N/m and milliseconds; assessed using MyotonPRO (Myoton AS), Estonia, 2021.
2.2. Reactive Strength Index (RSI) – measured in m/s; assessed with ForceDecks (Vald Performance), Germany, 2020.
2.3. Maximal voluntary contraction (MVC) – measured in Newtons (N); assessed using K-Force (Kinvent), Italy, 2023.
2.4. Tissue perfusion – measured in Perfusion Units (PU); evaluated using Laser Doppler Flowmeter (Perimed), Sweden, 2004.
2.5. Pressure pain threshold (PPT) – measured in kg/cm²; assessed with Algometer FPIX 25 (Medoc), USA, 2021.
2.6. Electromyographic activity (EMG) – measured in µV; recorded using TruScan EMG (Deymed), Germany, 2022.
2.7. Range of motion (ROM) – measured in degrees (°); assessed using Baseline Inclinometer, Italy, 2020.
2.8. Body composition (fat percentage, muscle mass) – measured in %; evaluated using Accuniq BC720, South Korea, 2021.

Secondary outcome measures

At baseline, after 2 weeks of intervention, and after 8 weeks. For long-term follow-up groups, we will also conduct measurements at 6 months:
1. Psychometric scales and questionnaires:
1.1. TQR (Total Quality Recovery 0–20 scale)
1.2. Subjective fatigue – assessed using the Borg Rating of Perceived Exertion Scale (6–20 points); international tool.
1.3. Perceived recovery – assessed using the TQR (Total Quality Recovery) Scale (6–20 points); international tool.
1.4. Pain intensity – assessed using the RNS Pain Scale (0–10 points); validated version used in Poland.
2. Maximal voluntary contraction (MVC) – measured in Newtons (N); evaluated using Kinvent K-Force (Kinvent), Italy, 2023.

Overall study start date

10/01/2025

Completion date

10/10/2026

Eligibility

Key inclusion criteria
1. Age between 18 and 45 years.
2. No contraindications to physical activity – confirmed by a physician.
3. Valid medical clearance for participation in physical training, issued within the past 6 months.
4. Regular physical training history, defined as:
4.1. At least 2 training sessions per week for a minimum of 1 year for amateur participants.
4.2. At least 6 training sessions per week for a minimum of 5 years for professional athletes, as classified according to the McKay et al. (2022) system.
5. Completed health screening questionnaire with no exclusionary findings.
6. Written informed consent to participate, signed voluntarily after being informed of the study protocol, risks, and benefits.

Participant type(s)
Healthy volunteer, Patient, Learner/student

Age group
Adult

Lower age limit
18 Years

Upper age limit
45 Years

Sex
Both

Target number of participants
100

Key exclusion criteria
1. Cardiovascular diseases or any medical contraindications to physical exertion.
2. Recent musculoskeletal injuries that limit activity and occurred within 3 months prior to study initiation.
3. History of orthopedic surgery involving the musculoskeletal system within the past 9 months.
4. Active skin diseases or unidentified skin lesions at the intended site of intervention (e.g., for compression devices).
5. Poor general health, excessive fatigue, or symptoms of sports-related depression.
6. Use of substances or medications affecting hemodynamics or masking physiological recovery markers, including:
6.1. Beta-blockers (e.g., metoprolol, bisoprolol)
6.2. Vasodilators (e.g., nitrates, calcium channel blockers)
6.3. Diuretics (e.g., furosemide, hydrochlorothiazide)
6.4. ACE inhibitors and sartans (e.g., enalapril, losartan)

6.5. Anticoagulants (e.g., heparins, NOACs such as apixaban, rivaroxaban)
7. Use of performance-enhancing drugs (doping substances).
8. Refusal to provide informed consent or voluntary withdrawal at any stage of the study.

Date of first enrolment
10/07/2025

Date of final enrolment
20/10/2025

Locations

Countries of recruitment
Poland

Study participating centre
Provita Medical Centre
al.Zjednoczonej Europy, 37
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Sponsor information

Organisation
Provita Medical centre

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Sponsor type
Hospital/treatment centre

Website
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Funder(s)

Funder type
Research council

Funder Name
Investigator initiated and funded

Results and Publications

Publication and dissemination plan
The study results will be published in peer-reviewed scientific journals and presented at national and international conferences.

Intention to publish date
10/01/2025

Individual participant data (IPD) sharing plan
The anonymized datasets will be available upon request from Dr hab. Robert Trybulski (rtrybulski@rehabilitacja-provita.pl), after study completion in October 2026, for 5 years. Access will be granted following formal request and ethical approval. Participant consent for data reuse in anonymized scientific analyses has been obtained.

IPD sharing plan summary
Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Protocol file			23/06/2025	No	No