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The influence of selected forms of physical training on hypertrophic changes in deep trunk muscles assessed in imaging studies and selected functional parameters – a randomized controlled trial

Submission date	Recruitment status	[ ] Prospectively registered
10/02/2025	No longer recruiting	[ ] Protocol
Registration date	Overall study status	[ ] Statistical analysis plan
12/03/2025	Ongoing	[ ] Results
Last Edited	Condition category	[ ] Individual participant data
12/03/2025	Other	[ ] Record updated in last year

Plain English summary of protocol

Background and study aims
This study focuses on spinal stability and muscle health, particularly the role of deep abdominal and paraspinal muscles in trunk stabilization and movement. When these muscles weaken due to lack of physical activity or ageing, they can transform into connective or fat tissue, leading to postural dysfunction, back pain, and reduced mobility. The aim of this study is to evaluate the effects of different types of trunk stabilization training on:
1. Structural changes in the paraspinal and abdominal muscles
2. Trunk mobility and functional movement patterns
3. Intervertebral disc health
To achieve this, three types of core training will be assessed:
1. Training based on natural movement patterns
2. Core stabilization training with ultrasound feedback (sonofeedback method)
3. Rotational exercises for improved spinal function

Who can participate?
Healthy volunteers aged 18 to 45 years

What Does the Study Involve?
The study is divided into three phases:
Phase 1: Initial Assessment (Pre-Training Phase)
Participants will complete a questionnaire and sign an informed consent form.
The following assessments will be conducted:
1. Body composition analysis (weight, muscle mass, etc)
2. Ultrasound measurement of abdominal muscles
3. Functional movement tests to assess trunk mobility
If eligible, participants will undergo an MRI scan of the lumbar spine to evaluate muscle

structure and intervertebral discs.
Participants will be randomly assigned to either a training group or a control group.
Training schedules will be arranged accordingly.

Phase 2: Training Phase (4 Weeks)
Participants will engage in four training sessions per week (each lasting up to 60 minutes).
1. Two sessions will be supervised by a physiotherapist at the Medical University of Silesia in Katowice.
2. Two sessions will be completed independently at home, following a structured program.

Phase 3: Final Assessment (Post-Training Phase)
The same tests as in Phase 1 will be conducted again. The before-and-after results will be compared to evaluate the effectiveness of the training interventions.

What are the possible benefits and risks of participating?
Participants will enhance their physical fitness and learn proper exercise techniques. The study aims to expand knowledge on core stabilization training and its impact on spinal function and lower back pain relief. The findings may contribute to better rehabilitation programs and physiotherapy practices.
The study is minimally invasive and does not pose any health risks or dangers. Participants should continue their usual daily activities while following the provided guidelines.

Where is the study run from?
Medical University of Silesia in Katowice (Poland)

When is the study starting and how long is it expected to run for?
February 2024 to December 2026

Who is funding the study?
Medical University of Silesia in Katowice (Poland)

Who is the main contact?
Dr Katarzyna Szuścik-Niewiadomy, kszuscik@sum.edu.pl

Contact information

Type(s)
Public, Scientific, Principal investigator

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Additional identifiers

Protocol serial number
BNW/NWN/0052/KB1/69/24

Study information

Scientific Title
Effects of selected forms of physical training compared to a control group on hypertrophic changes in deep trunk muscles and functional parameters in adults: a randomized controlled trial

Acronym
CORE-TRAIN

Study objectives
1. Proper motor function is associated with the activation and endurance of muscles stabilizing the hip-pelvic-lumbar complex.
2. The development of core stability influences hypertrophic changes in the lateral abdominal wall muscles and trunk mobility, and it is dependent on the type of training implemented.
3. Trunk rotation movement in low positions is a crucial factor in establishing appropriate muscle tension and segmental spinal stabilization.
4. Core stabilization training affects the tension of the posterior myofascial chain.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 17/09/2024, Ethics Committee of Medical University of Silesia in Katowice (Poniatowskiego 15, Katowice, 40-055, Poland; +48 (0)32 208 35 46; kombioet@sum.edu.pl), ref: BNW/NWN/0052/KB1/69/24

Primary study design
Interventional

Study design
Randomized control trial

Study type(s)
Prevention, Treatment

Health condition(s) or problem(s) studied
Effects of core muscle training in healthy adults

Interventions
The whole experiment will last for about 6 weeks. Every participant will go through a specific examination, including an interview, warm-up, functional tests, self-made questionnaires and

imaging studies (USG, MRI). It will take up to 90 minutes. After that, patients will be randomly assigned to one of the experimental groups (with a specific training programme) and one control group (without any training). The examination will be done at two times: Initial measurement (before training starts), and second measurement after the last training session.

A 4-week training intervention will consist of selected forms of physical training:
Training based on global movement patterns in the frontal and sagittal planes in low positions, including front, side, and back bridge positions, with short and long levers, quadruped position, and sumo squat.
Core stabilization training with anticipatory activation of the transverse abdominis muscle, in which sonofeedback will be used for learning and evaluating isolated muscle activity (i.e., real-time observation of transverse abdominis tension using ultrasound during exercise).
Training based on rotational trunk patterns in the transverse plane in low positions, including supine position, global rolling patterns, quadruped position with contralateral limb movement, and crawling patterns. The movement patterns are inspired by observations of spontaneous motor development in infants during the first year of life.
The training intervention will last 4 weeks and will include four training sessions per week, each lasting up to 60 minutes. Two sessions will be supervised by a physiotherapist, while the other two will be performed independently according to the provided instructions. Participants will be required to submit a report on their completed training sessions.
Each of the 16 training units is structured with a detailed breakdown, including the exercise type, number of repetitions, number of sets, and duration.
Exercise modifications will be made in accordance with the principle of progressive difficulty and the principles of functional training, utilizing bodyweight exercises.

Block randomization will be used.

The study will be conducted with investigator blinding, meaning that the researchers assessing the outcomes will be unaware of the participants' group allocation. While the participants will know they are engaging in physical training, they will not be informed about the specific purpose or objectives of the training program.

Intervention Type
Behavioural

Primary outcome(s)
Timepoints: The first measurement (T1) will be conducted before the start of the intervention, and the second measurement (T2) will take place after 4 weeks, upon completion of the training intervention.

1. Thickness of the lateral abdominal wall muscles (transverse abdominis, internal oblique, and external oblique) measured using the EDAN DUS 60 ultrasound system with a linear transducer, recorded in millimeters (mm) at T1 and T2
2. Trunk mobility in the sagittal plane measured using the Finger Tip-to-Floor test, conducted on a dedicated platform with a centimeter scale, recorded in centimeters (cm) at T1 and T2
3. Trunk mobility in the frontal plane measured using the lateral trunk flexion test, performed using a Saunders digital inclinometer, recorded in degrees (°) at T1 and T2
4. Trunk mobility in the transverse plane measured using the trunk rotation test in both seated and standing positions, recorded on a centimeter scale (cm) at T1 and T2.
5. Thickness of the paraspinal muscles (multifidus muscle) and erector spinae measured using magnetic resonance imaging (MRI) (3T, sequences: SagT2, SagT1, Sag T2 FS, Ax T2, imaging level

L1-S1). Measurements will include muscle thickness in millimeters (mm) and cross-sectional area (CSA) in square millimeters (mm²) at T1 and T2.
6. Height of the intervertebral discs measured using MRI, will be recorded in millimeters (mm) at T1 and T2
7. Degenerative changes in the intervertebral discs assessed using the Pfirrmann Grading System, a five-grade scale, at T1 and T2.

Key secondary outcome(s)
Timepoints: The first measurement (T1) will be conducted before the start of the intervention, and the second measurement (T2) will take place after 4 weeks, upon completion of the training intervention.

1. Pain levels from the last 7 days measured using the Visual Analogue Scale (VAS) scale. The result will be recorded in points at T1 and T2.
2. Level of physical activity assessed using the International Physical Activity Questionnaire (IPAQ)[MET-min/week]. The result will be recorded in MET-minutes per week (MET-min/week) at T1 and T2.
3. Body composition, including body mass (kg) and Body Mass Index (BMI) (kg/m²), measured using Tanita body composition analyzer at T1 and T2.

Completion date
30/12/2026

Eligibility

Key inclusion criteria
1. Aged 18 to 45 years
2. BMI ≤29.9 kg/m²
3. No health contraindications for participation in the training program outlined in the research experiment
4. Written consent to participate in the study

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 Years

Upper age limit
45 Years

Sex
All

Key exclusion criteria
1. Presence of spinal pain with an intensity 5 points on the Visual Analogue Scale (VAS)
2. Presence of neurological symptoms
3. Previous surgical procedures or scars in the abdominal region
4. Diagnosed chronic disease
5. For female participants – pregnancy and/or menopause
6. Lack of reliable participation in the training program, including missing at least one training session
7. Ongoing pharmacotherapy, including the use of painkillers during the study
8. Withdrawal from the study at any stage

Date of first enrolment
17/09/2024

Date of final enrolment
01/10/2026

Locations

Countries of recruitment
Poland

Study participating centre
Medical University if Silesia in Katowice
Medyków 12
Katowice
Poland
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Sponsor information

Organisation
Medical University of Silesia

ROR
https://ror.org/005k7hp45

Funder(s)

Funder type
University/education

Funder Name
Medical University of Silesia in Katowice

Alternative Name(s)
Silesian Medical University, Śląski Uniwersytet Medyczny w Katowicach, Śląski Uniwersytet Medyczny, Medical University of Silesia, Katowice, Poland, SUM

Funding Body Type
Government organisation

Funding Body Subtype
Local government

Location
Poland

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request from Dr Katarzyna Szuścik-Niewiadomy (kszuscik@sum.edu.pl).
The type of data that will be shared: The decision regarding the scope of data will be made upon the request of the interested party.
Dates of availability: During the course of the study.
Whether consent from participants was required and obtained: A formal written consent from the participant to take part in the study was required on a form in accordance with the template provided by the Bioethics Committee of the Medical University of Silesia in Katowice
Comments on data anonymization: The collected personal data will be anonymized.
Any ethical or legal restrictions: The study was approved by the Ethics Committee of the Medical University of Silesia in Katowice (Approved on 17/09/2024).

IPD sharing plan summary
Available on request