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Evaluating an exercise game session in the ExerCube

Submission date	Recruitment status	[X] Prospectively registered
13/04/2020	No longer recruiting	[_] Protocol
Registration date	**Overall study status**	[_] Statistical analysis plan
14/04/2020	Completed	[X] Results
Last Edited	**Condition category**	[_] Individual participant data
12/06/2023	Other	

Plain English summary of protocol

Background and study aims
Exergames, are a new generation of interactive video games that stimulate an active, gaming experience. By combining electronic entertainment with physical exercise, exergames create novel opportunities to expand physical activity in different age groups and settings. Due to their playful, and motivational nature exergames appear to be a suitable and appealing tool to facilitate physical activity. Even though studies have found a significant increase in energy expenditure when playing exergames compared to normal video games, most games only induce low to moderate-intensity activity, which is claimed to be too low to result in relevant physical adjustments. In the present study, we will evaluate the effectiveness of a new, high-intensity functional fitness game called the ExerCube. Therefore, we compare different physiological and psychological responses of a single session in the ExerCube to the responses of a standardized exercise test as well as a moderate endurance training session.

Who can participate?
Young and healthy adults (male/female) in Halle (Saale), Germany, aged 18-35 willing to take part in the study.

What does the study involve?
Subjects that consent to take part in the study will undergo a medical screening and a standardized graded exercise test on a treadmill to assess maximal oxygen consumption (VO2max) and maximal heart rate (HRmax). After this baseline assessment, subjects participate in two different exercise session. A moderate endurance exercise session and an exergame session in the ExerCube.
Before and after the training sessions lactate, blood pressure and different hemodynamic parameters are assessed at rest and thereafter, during a Cold Pressor Test (CPT). Additionally, different questionnaires are administered to assessed flow-experience and enjoyment during the exercise.
What are the possible benefits and risks of participating?

The participants will receive a performance diagnostic and an analysis of their performance and health status. Additionally, they have the chance to try out a new and appealing exergame. There is little risk to participants taking part in the study. Participants can withdraw at any time.

Blood sampling from the earlobe is performed as part of the test procedure to determine lactate thresholds. Slight traumatization may occur with bruising of the earlobe. The graded exercise tests on the treadmill represent an intensive exercise. However, serious incidents are extremely rare in healthy individuals. Scientific studies have shown that life-threatening complications in fit and healthy have not occurred so far. In 1,356,168 patients, the most common complication was ventricular fibrillation (probability 1 in 15,000).
As both exercise protocols (ExerCube and Endurance training) are heart rate monitored there exists no specific risk for the subjects.

Where is the study run from?
This study is being run by the Martin-Luther-University Halle-Wittenberg (Germany) and takes place in Lab of the Institute of Sport Science.

When is the study starting and how long is it expected to run for?
April 2020 to June 2020

Who is funding the study?
Investigator initiated and funded

Who is the main contact?
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Contact information

Type(s)
Scientific

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Additional identifiers

Clinical Trials Information System (CTIS)
Nil known

Protocol serial number
Nil known

Study information

Scientific Title
Evaluating metabolic, hemodynamic and perceptual responses during an exergame session in the ExerCube

Study objectives
1. An exercise session in the ExerCube provides a form of vigorous physical activity reaching >70% of HRmax, and >60% of VO2max
2. Energy expenditure (EE) during the exercise in the ExerCube exceeds EE during a moderate endurance training on the treadmill
3. Post-exercise hypotension effect (PEH) after the session in the ExerCube is comparable to the PEH after the moderate endurance exercise on a treadmill
4. Blood pressure reaction to a cold-pressor test is attenuated after the exercise session in the ExerCube
5. Physical activity enjoyment and flow experience are higher during the exercise in the ExerCube compared to a moderate endurance training on the treadmill

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 17/03/2020, Ethics Committee of the Medical Faculty, Martin Luther University Halle-Wittenberg (Magdeburger Straße 16, 06112 Halle (Saale); +49 345 5574476; ethic-kommission@uk-halle.de), ref:2019-177

Study design
Interventional randomised cross over study

Primary study design
Interventional

Study type(s)
Other

Health condition(s) or problem(s) studied
Exercise

Interventions
The initial examination begins with the collection of the anthropometric parameters body height, weight, body composition. In addition, an ECG is written, and various hemodynamic parameters are recorded.

Thereafter a graded exercise test on the treadmill is performed to determine VO2max and HRmax. The test begins at a speed of 7, 8.5 or 10 km/h (depending on the performance level of each subject). Each stage lasts 3 min, interspersed with a 1-minute rest to draw lactate samples. After each stage, the speed is increased by 1.5 km/h.

The test days two and three take place at intervals of at least 24 hours. On these days the training in the ExerCube and the moderate endurance exercise are carried out. The allocation of

which subject starts which type of training is randomized. The randomization process is conducted by the principal investigator using a computer-generated random number table in the presence of other noninvolved researchers.

Before the two test protocols (ExerCube, moderate endurance exercise), selected hemodynamic parameters are recorded both at rest and during a standardized stress test, the so-called cold pressor test (CPT). During the CPT subjects are asked to immerse their left hand into a bucket of 5°C cold water for two minutes.

After both exercise protocols, lactate is assessed, and different questionnaires (PACES, Flow short scale) are administered. Subsequently, subjects rest in a supine position and hemodynamic parameters are assessed 15, 30 and 45 minutes after termination of the exercise session. After the last measurement, a CPT is conducted again.

ExerCube Session
The ExerCube is a holistic, and adaptive fitness game setup. During the game, the player is surrounded by three walls, which simultaneously serve as a projection screen and haptic interface. The player navigates an avatar on a hoverboard along a racing track and has to perform different movement tasks (squats, launches, punches, burpees, e.g.). A precise motion capturing system continuously tracks the players' movement and body position. Players wear two trackers, attached to their wrists and two trackers attached to their ankle. The game implements six dynamic movement levels which gradually guide the player through a training lasting 25 minutes.
During the exercise session VO2, and HRmax is assessed continuously. Furthermore, subjects are asked to evaluate RPE at 5 timepoints during the exercise.

Moderate Endurance Exercise
During the moderate endurance exercise subjects have to perform an endurance run on a treadmill for 25 minutes (+10 min. warm-up and 5 min. cool-down) at an exercise intensity of 65-70% of HRmax. During the exercise session VO2, and HRmax is assessed continuously. Furthermore, subjects are asked to evaluate RPE at 5 timepoints during the exercise.

Intervention Type
Behavioural

Primary outcome(s)
1. Oxygen consumption (VO2) (MetMax 3B Cortex): VO2 will be measured during the graded exercise test on the treadmill, and throughout both exercise sessions (ExerCube, moderate endurance exercise training)
2. Peripheral systolic and diastolic blood pressure (Mobil-O-Graph 24 PWA monitor, IEM, Stolberg GERMANY). Blood pressure will be measured before and after the two exercise protocols

Key secondary outcome(s))
1. Heart rate (Polar Rs800cx, Kempele, Finnland). The heart rate will be measured during the graded exercise test on the treadmill, and throughout both exercise sessions (ExerCube, moderate endurance exercise training)
2. Anthropometric measures (height, weight, waist circumference, body composition) (Tanita BC545N Tokyo, Japan). Weight will be assessed before and after each exercise session. Height, waist circumference and body composition will be measured during the initial examination
3. Physical Activity Enjoyment (Physical Activity Enjoyment Scale). The physical activity

enjoyment will be assessed after the exercise session in the ExerCube and after the moderate endurance exercise training
4. Lactate acid (blood sampling from the earlobe). Blood sampling from the earlobe will be taken after each stage of the graded exercise test and before, and after each exercise session
5. Rate of perceived exertion (BORG-RPE-Scale). Subjects are asked to evaluate RPE at each stage of the graded exercise test and at different time points during both exercise sessions
6. Flow-experience (Flow short scale). The flow-experience will be assessed after the exercise session in the ExerCube and after the moderate endurance exercise training

Completion date
01/06/2020

Eligibility

Key inclusion criteria
1. Young, healthy female and male adults aged 18-35 years
2. Free from acute and chronic diseases, movement restrictions or injuries to the musculoskeletal system

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 years

Upper age limit
35 years

Sex
All

Total final enrolment
28

Key exclusion criteria
Does not meet inclusion criteria

Date of first enrolment
20/04/2020

Date of final enrolment
01/05/2020

Locations

Countries of recruitment
Germany

Study participating centre
Martin-Luther-University Halle-Wittenberg
von-Seckendorff-Platz 2
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Germany
06120

Study participating centre
MSB Medical School Berlin GmbH
Rüdesheimer Straße 50
Berlin
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14197

Study participating centre
Charité – University Medicine Berlin
Charitéplatz 1
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Sponsor information

Organisation
Martin Luther University Halle-Wittenberg

ROR
https://ror.org/05gqaka33

Funder(s)

Funder type
Other

Funder Name

Investigator initiated and funded

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.

IPD sharing plan summary
Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		23/09/2021	27/09/2021	Yes	No
Results article		26/01/2022	12/06/2023	Yes	No
Results article		27/01/2022	12/06/2023	Yes	No