



ICAROS

Studies

Munich
May 2026

Research Partners



UCLA



University of Salzburg



Ruhr-University-Bochum



Cologne University of Sport



Technical University of Munich



University of Heidelberg



Center for Healthcare Professions Tyrol

Overview

ICAROS Guardian

Study G-I

Effects of exergame-based balance training on mobility, balance, cognition, and walking speed in older adults

Study G-II

Exergame-based training to promote mobility and cognitive function in older adults

ICAROS Pro / Health

Study H-I

Effects of Icaros Training on Function and Trunk Strength in Lumbar Spine Patients

Study H-II

Energy Expenditure and Muscle Activity During Workouts on the Innovative ICAROS Fitness Machine

Study H-III

Effects of full-body exergaming in virtual reality on cardiovascular and muscular parameters

Study H-IV

Evaluation of ICAROS VR Training for Health Promotion and Prevention

Study H-V

Exergame-based flight simulation and therapeutic training for nonspecific acute low back pain

Study H-VI

VR exercise therapy for Post-COVID fatigue

ICAROS Cloud

Study C-I

Cardiopulmonary and metabolic stress during ICAROS Cloud training

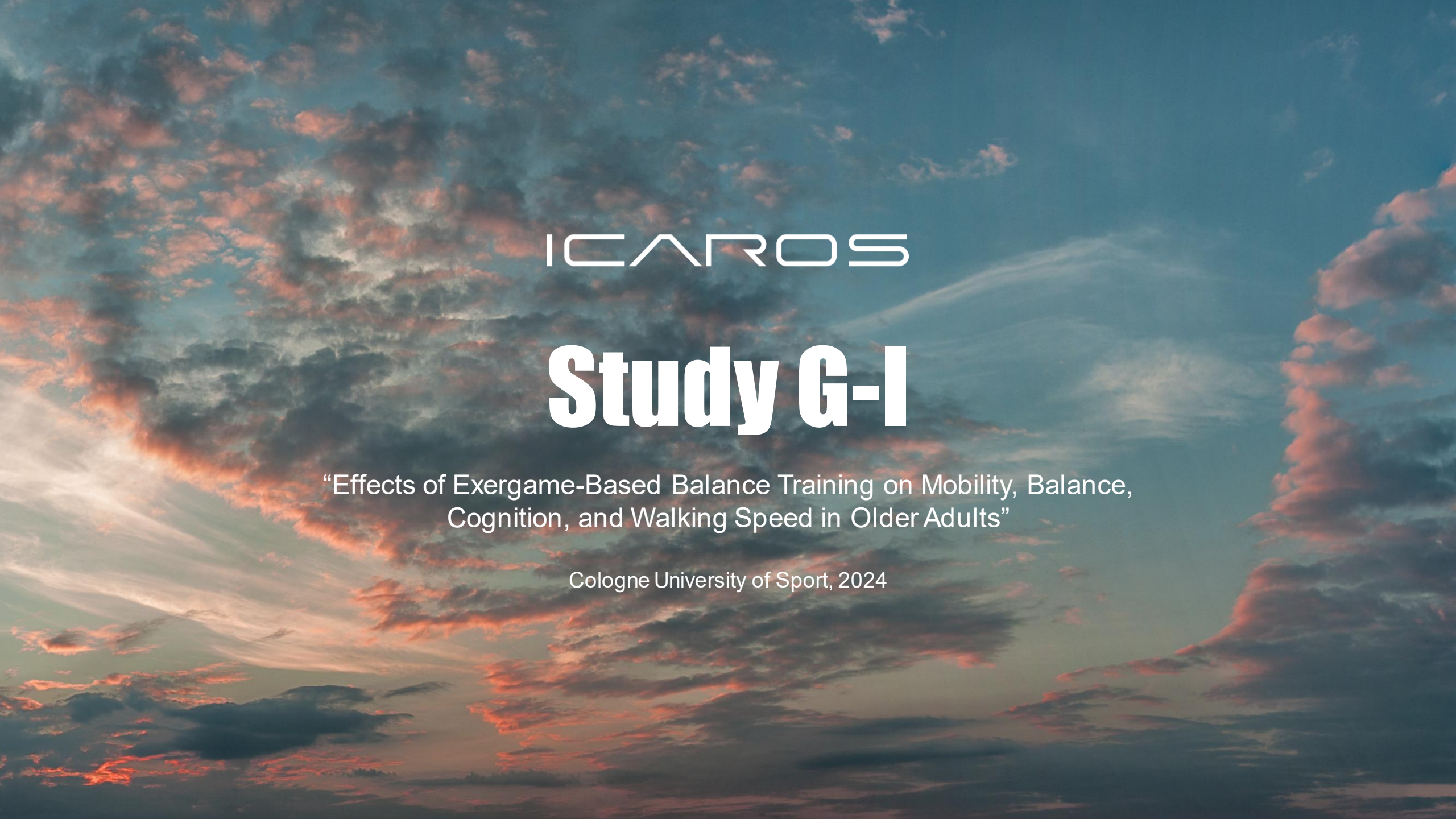
Study C-II

Does regular training on the Icaros Cloud improve core strength?

ICAROS Lightning

Study L-I

Effect of ICAROS Lightning Dynamic Stability Warm-up on Shoulder Joint Position Sense in Baseball Players



ICAROS

Study G-I

“Effects of Exergame-Based Balance Training on Mobility, Balance, Cognition, and Walking Speed in Older Adults”

Cologne University of Sport, 2024

Study G-I

Goal: A Study of the Efficacy of a 6-Week Exergame Training Intervention Using the ICAROS Guardian in Healthy Older Adults

Sample:

Intervention Group (n=10):	76,7 ± 7,54 years
Control Group (n=12):	70,9 ± 4,09 years

Methods:

- Duration: 6 weeks
- Frequency: twice a week
- Session length: 20–25 minutes

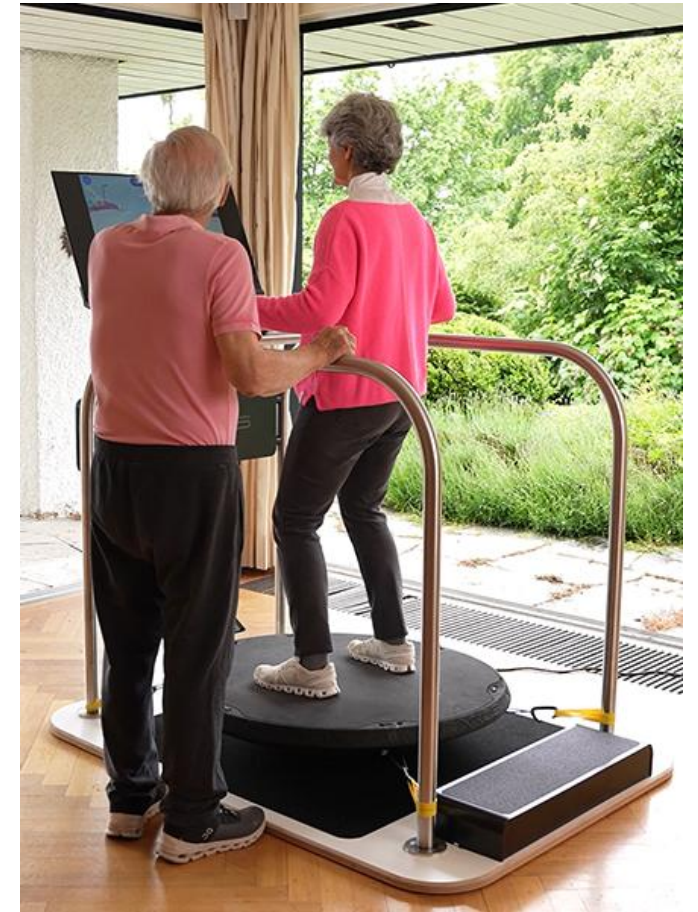
Diagnostics:

Physical:

- Timed Up and Go (TUG)
- Sit to Stand (STS)
- Walking Speed Test (WST)

Cognitive/ Dual-Task:

- Montreal Cognitive Assessment (MoCA)
- Trail Making Test (TMT) A&B
- Dual Task Timed Up and Go (DT-TUG)



Study G-I

Results:

Physical fitness:

- Significant increase in leg strength (STS test)
- Improvement in functional mobility (TUG test)
- Increase in walking speed

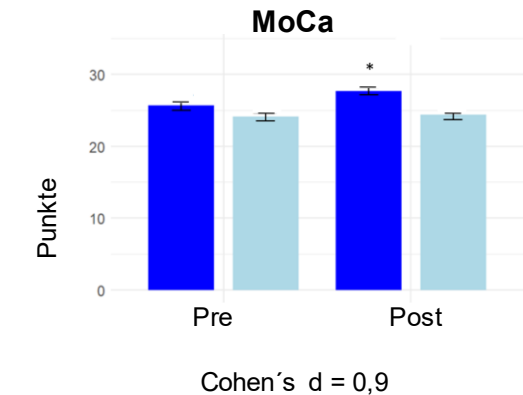
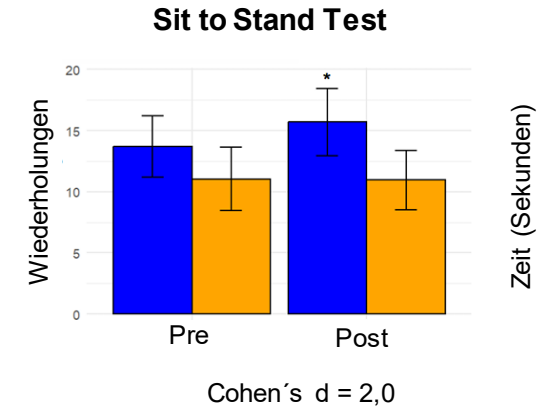
Cognition & Dual-Task:

- Significant improvement in global cognition (MoCA)
- Improvement in dual-task ability (DT-TUG)

Conclusion:

The ICAROS Guardian shows great potential for promoting physical and cognitive function in older adults.

Significant positive effects were already evident after a shortened, six-week training program.



* $p < 0.05$ vs. pre



ICAROS

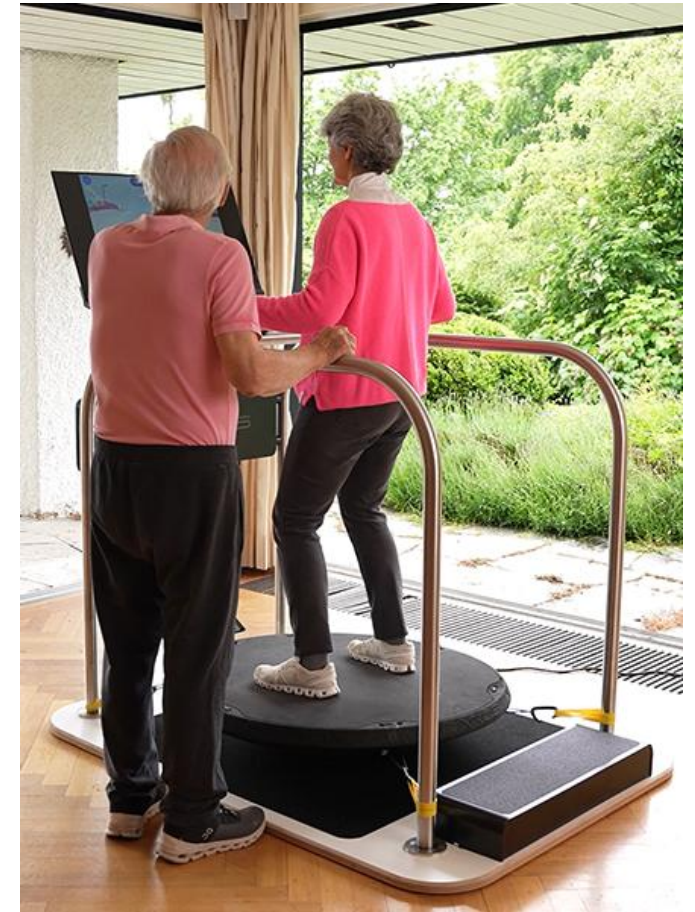
Study G-II

“Exergame-Based Training to Promote Mobility and Cognitive Function in Older Adults: A Feasibility Study”

Cologne University of Sport, 2026

Study G-II

- Goal:** A study of the effectiveness of a multi-week exergame training intervention using the ICAROS Guardian among older adults living at home and geriatric rehabilitation patients.
- Sample:**
- Community Dwelling (CD):** n = 12, age: 70.9 ± 4.1 years
 - Geriatric rehabilitation patients (GR):** n = 15, age: 84.7 ± 4.2 years
- Methods:**
- CD:** 6 weeks, 2 times a week, 20–25 minutes of training on the ICAROS Guardian
 - GR:** 3 weeks, 5 times a week, 20–25 minutes of training on the ICAROS Guardian
- Diagnostics:**
- Physical:**
 - Timed Up and Go (TUG) under single-task (ST) and dual-task (DT) conditions
 - Sit to Stand (STS)
 - Walking Speed Test (WST)
 - Kognitiv/Dual-Task:**
 - Montreal Cognitive Assessment (MoCA)



Study G-II

Results:

Physical fitness:

- Significant increase in leg strength (STS)
- Improvement in functional mobility (TUG) single task
- Significant increase in walking speed

Cognition & Dual-Task:

- Significant increase in global cognition (MoCA)
- Trend toward improved dual-task mobility

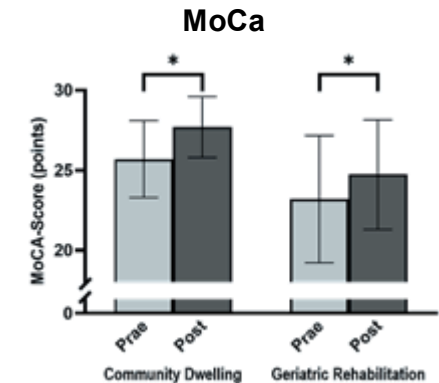
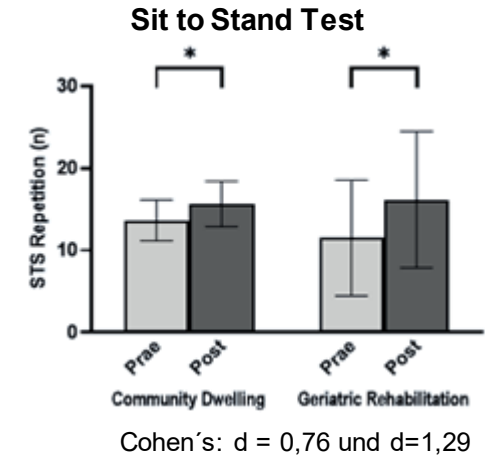
Conclusion:

The ICAROS Guardian training program effectively improves physical fitness (leg strength, mobility, walking speed) as well as cognitive performance in older adults and rehabilitation patients.

The program has proven to be a practical, motivating, and time-saving alternative to traditional training methods in both home and clinical settings.

Published in:

German Journal of Sports Medicine 2/2026



* $p < 0.05$ vs. pre



ICAROS

Study H-I

“The Effect of Additional Icaros Training During Post-Rehabilitation Follow-Up Care for Patients with Lower Back Pain on Their Daily Functional Limitations and Core Muscle Strength”

Technical University of Munich, 2018

Study H-I

Goal: Evaluation of the effects of additional Icaros training on subjectively perceived limitations in daily life and on core muscle strength parameters in patients with lower back pain.

Sample:

20 participants:	46,55 ± 11,31 years
Intervention group (n=9):	An additional 10-minute training session on the ICAROS Pro
Control group (n=11):	only the standard follow-up program

Methods: Intervention study, patients in lumbar spine follow-up care
Structure: Pre-test, 12 follow-up sessions (with or without ICAROS training), Post-test

Diagnostics: **Oswestry Disability Questionnaire**
(Subjective assessment of functional impairment)

Isokinetic measurement: 5 times at 60°/s, 15 times at 90°/s

Isometric measurement: 60°, 45°, 30° flexion,
extensor-to-flexor ratio



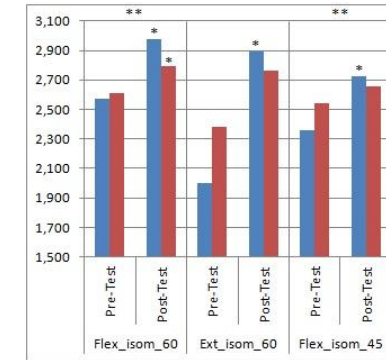
Study H-I

Results:

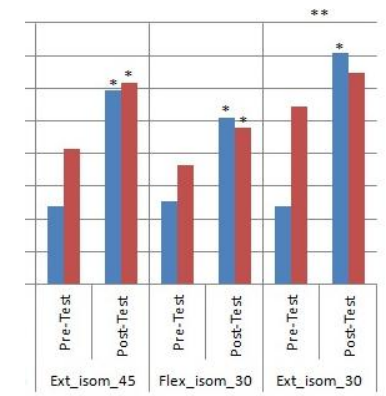
- Significant improvements in the intervention group:
 - Isometric flexion (60° and 45°)
 - Isometric extension and strength ratio at 30° flexion
- Isokinetic strength ratios did not improve significantly; a possible explanation is pain-induced inhibition
- Increased motivation due to ICAROS training

Conclusion:

Icaros training significantly increases isometric core strength and reduces limitations in daily activities among patients with lumbar spine conditions.



■ Intervention
■ Control





ICAROS

Study H-II

“Energy Expenditure and Muscle Activity During Training on the Innovative ICAROS Fitness Machine”

Technical University of Munich, 2017

Study H-II

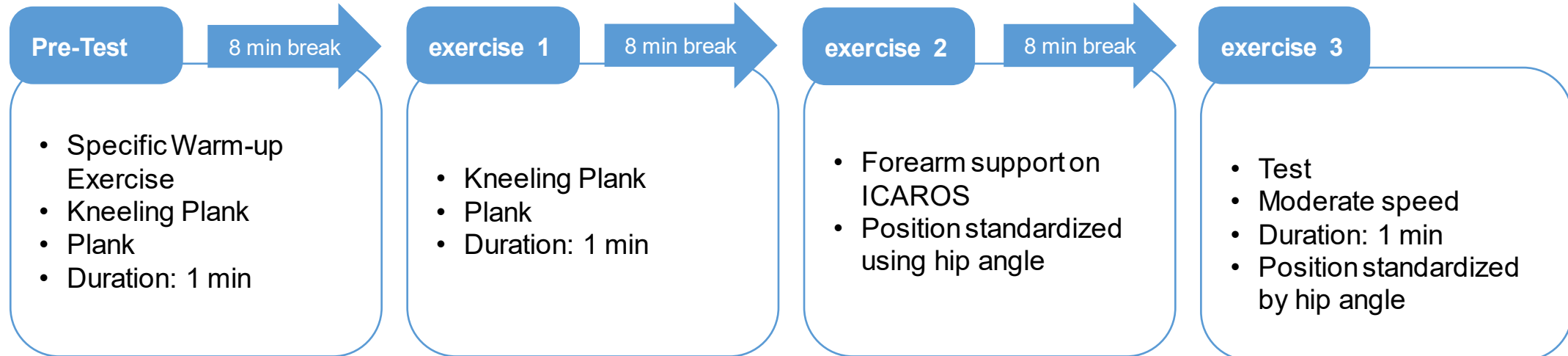
Goal:

Bestimmung des energetischen Verbrauchs (Kalorienverbrauch) sowie Analyse der muskulären Aktivitätsintensität beim Training mit dem ICAROS Pro.

Sample:

15 Probanden: 24,7 ± 2,6 Jahre

Methods:



Study H-II

Diagnostics:

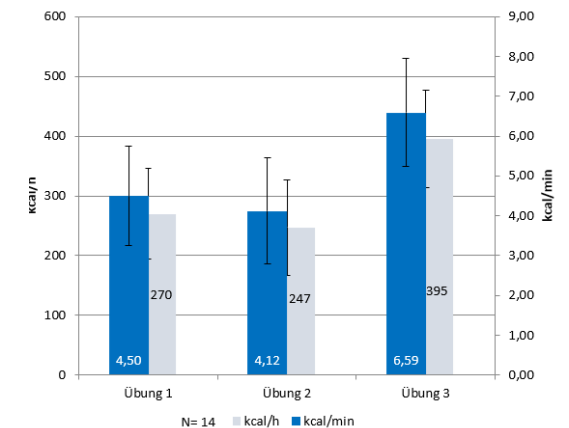
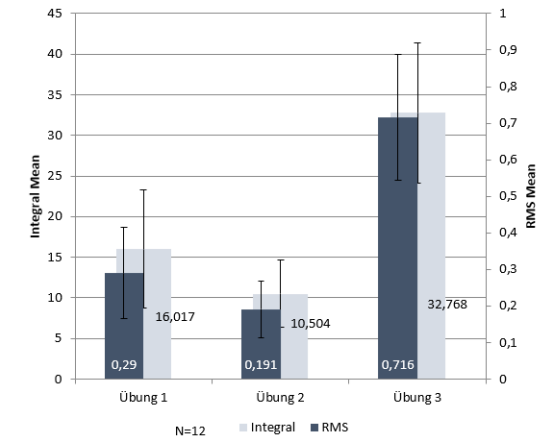
- Energy expenditure via oxygen uptake and blood lactate
- Muscle activity via EMG (comparison using RMS)

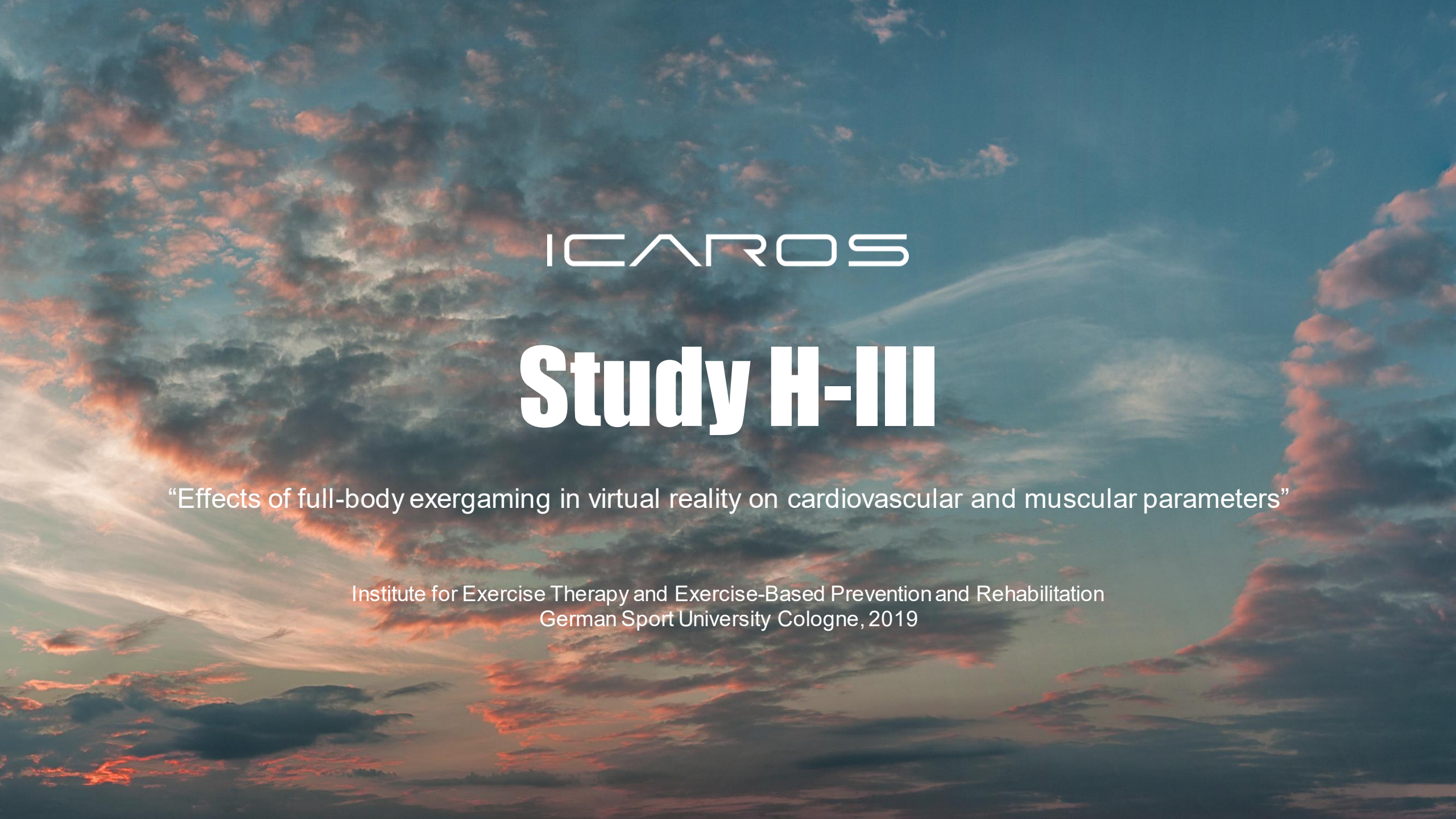
Results:

- **Muscle stimulation** doubled compared to standard forearm supports with bent knees.
- **Calorie expenditure** increased by 30% compared to standard forearm supports with bent knees.

Conclusion:

Thanks to its successful combination of playful incentives and high physical intensity, the ICAROS system has proven to be an effective, motivating training tool that stands out significantly from traditional static exercises.





ICAROS

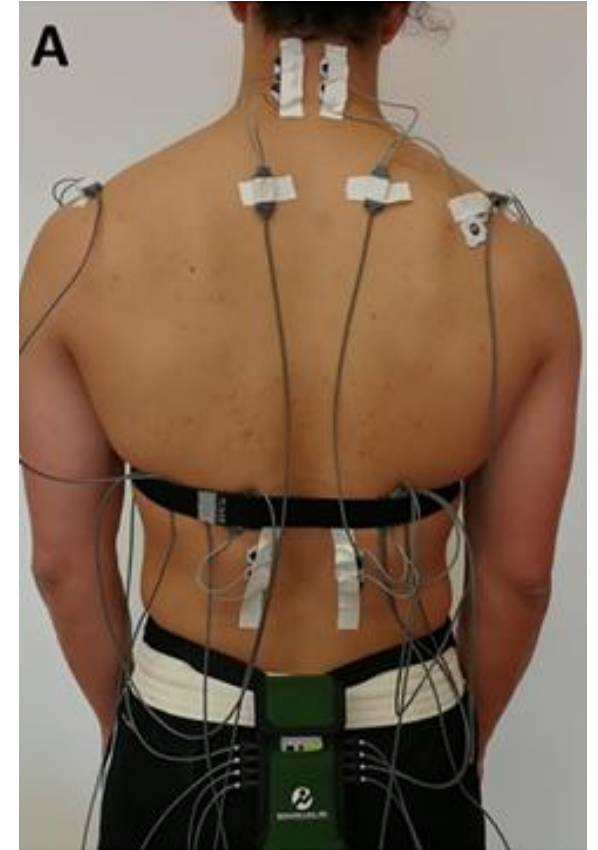
Study H-III

“Effects of full-body exergaming in virtual reality on cardiovascular and muscular parameters”

Institute for Exercise Therapy and Exercise-Based Prevention and Rehabilitation
German Sport University Cologne, 2019

Study H-III

Goal:	A study of the effects of a fully immersive, virtual reality (VR)-based training system on cardiovascular and muscular parameters in young adults. https://www.youtube.com/watch?v=ODcs1JU2W9Q		
Sample:	25 participants:	24.16 ± 4.82 years	
Methods:	Cross-sectional study: two 5-minute flights on the ICAROS, with a 15-minute break in between		
Diagnostics:	Muscle activity:	Surface electromyography (sEMG)	
	Cardiovascular:	continuous heart rate monitoring	
	Subjective perception:	• perceived rate of exhaustion (RPE) • cybersickness symptoms • perceived exertion • physical activity enjoyment (PACES)	

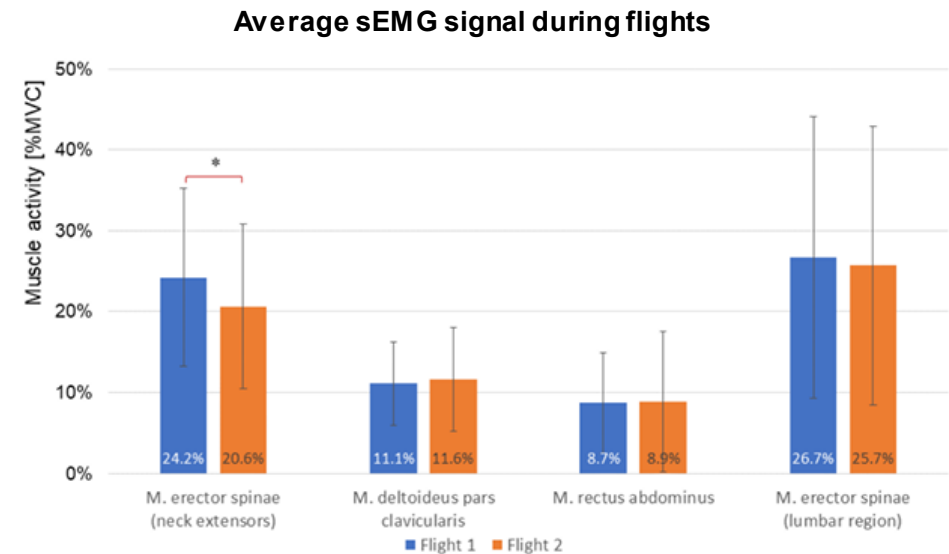


Study H-III

Results:	Muscle activity:	Effective activation of the back muscles (up to 30% of maximum isometric contraction)
	Cardiovascular:	moderate aerobic intensity, 108 ± 18.69 bpm
	Stress & Well-being:	Moderate to intense perceived intensity, high fun factor

Conclusion: Immersive VR systems can effectively contribute to muscle-strengthening activities. Technological advancements and the incorporation of sports science standards hold great potential for effective back training.

Published in: Journal „JMIR Serious Games“, 2019





ICAROS

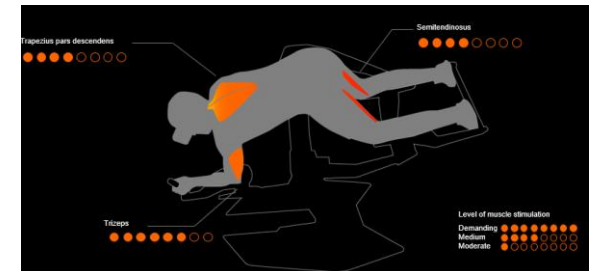
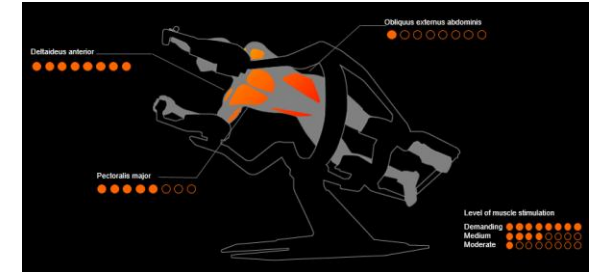
Study H-IV

“Evaluation of ICAROS VR Training for Health Promotion and Prevention”

Center for Healthcare Professions Tyrol, LLC, 2022

Study H-IV

Goal:	A study of the effectiveness of training with the ICAROS PRO device and ICAROS AIM software in virtual reality (VR) with regard to body composition, muscle function, muscle thickness, and participant acceptance.	
Sample:	36 participants:	Ages 26–65, male
Methods:	Pre-test, 6-week training program on the ICAROS Pro, 3 times a week for 10 minutes each session, post-test, and follow-up via questionnaire	
Diagnostics:	Body composition:	Body Mass Index, bioelectrical impedance analysis
	Isometric Force Measurement:	Biering- Sørensen Test & McGill Test
	Muscle thickness:	Sonoscape E2 ultrasound device on rectus abdominis muscle, internal oblique muscle, rhomboid muscle

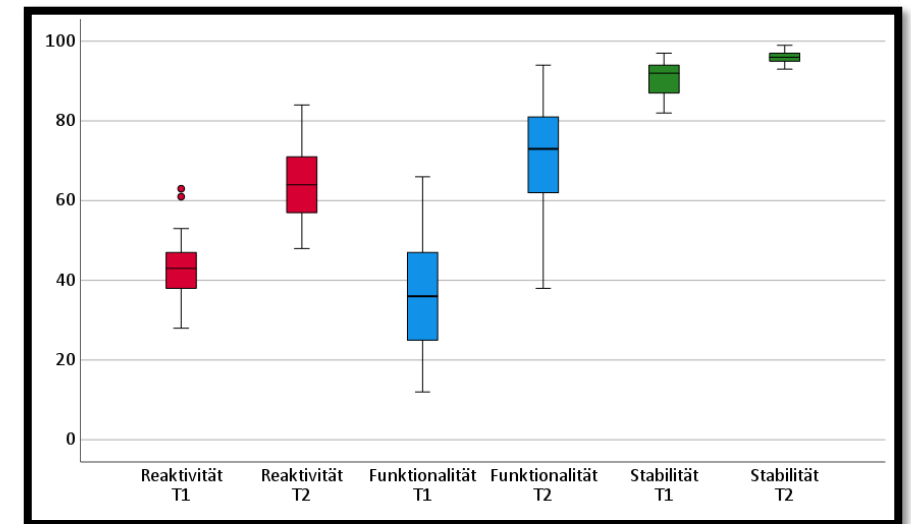


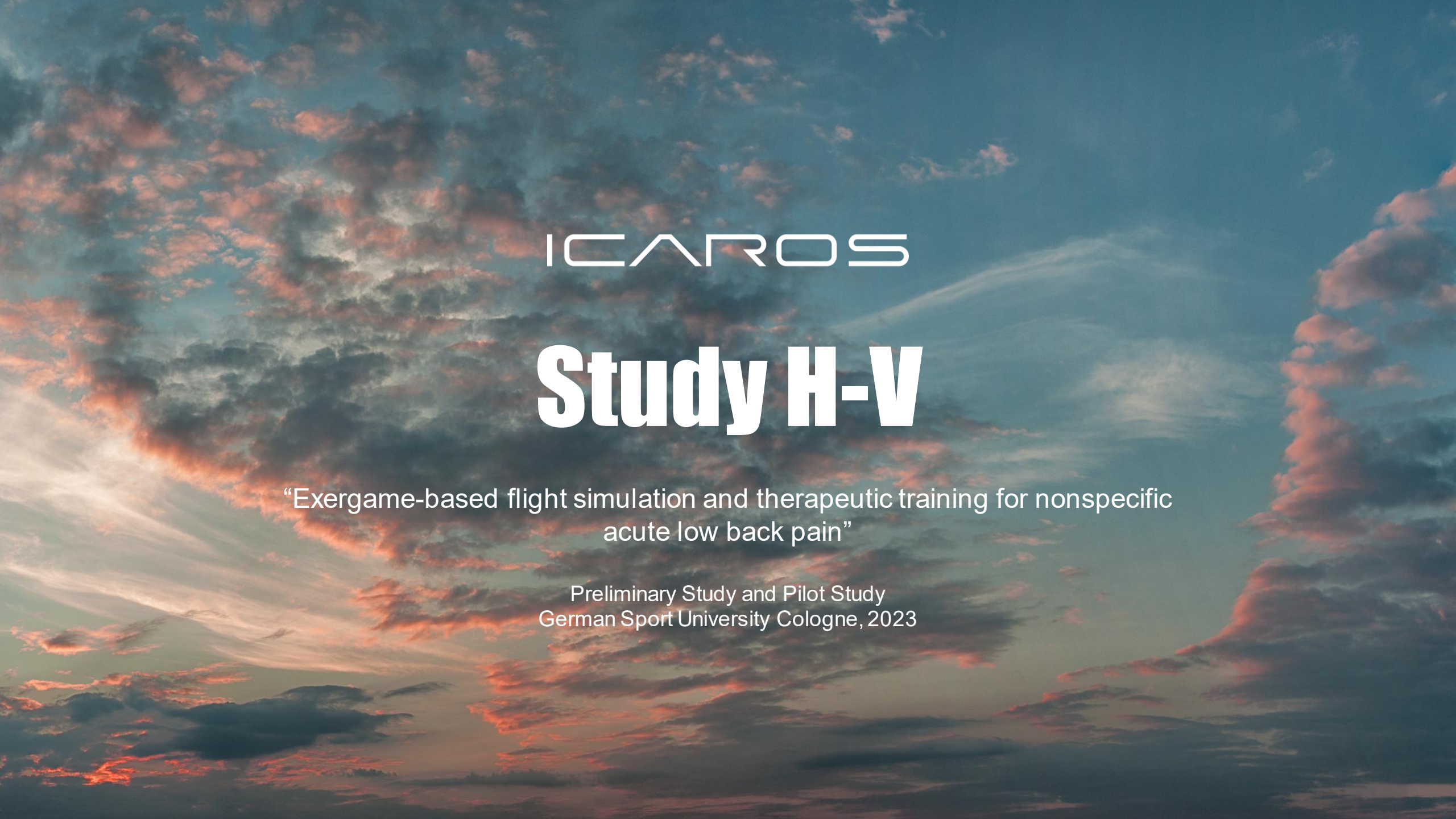
Study H-IV

Results:	Muscle activity:	a significant increase from 43.0% to 59.4% (paired t-test, $t=14.5$; $p<0.001$; $d=2.42$)
	Muscle function:	a significant increase from 37.7% to 63.3% (paired t-test; $t=15.9$; $p<0.001$; $d=2.64$)
	Stability:	a significant increase from 93.2% to 94.6% (paired t-test; $t=8.4$; $p<0.001$; $d=1.40$)

Conclusion: A six-week training program using the ICAROS led to significant improvements in muscle function, responsiveness, and stability. In addition, participants reported a noticeable reduction in their back pain and improved mobility.

Published in: Proceedings of the 15th Research Forum of Austrian Universities of Applied Sciences (FFH), Villach 2022





ICAROS

Study H-V

“Exergame-based flight simulation and therapeutic training for nonspecific acute low back pain”

Preliminary Study and Pilot Study
German Sport University Cologne, 2023

Study H-V

Goal:

A study of the effectiveness of an exergame-based back training program in the unstable plank position in terms of improving acute back pain, pain perception, functional mobility, and overall well-being.

Sample:

1. **Preliminary study**
 - n=6, 22 ± 2 years, **no back pain**
 - n=4, 57 ± 8 years, **no back pain**
2. **Pilot study**
 - Control group: n=6, 35 ± 13 years, **acute low back pain**
 - Intervention group: n=4, 47 ± 14 years, **acute low back pain**

Methods:

Pilot study: 6 weeks of 20 minutes of exergaming and 10 minutes of core stabilization per session; Week 1: 4 times per week, then 2 times

Diagnostics:

- Pain perception (NRS)
- Mobility
- Well-being (WHO 5)
- Finger-to-floor distance (FBA)



Study H-V

Results:

Preliminary study:

Both young and older healthy participants showed positive adaptation to and familiarity with the device after four days

Pilot study:

Improved function of the back muscles in participants with back pain, as well as increased well-being, through a potential reduction in acute back pain

Conclusion:

The results show that users of all age groups adapt quickly to the ICAROS system. In clinical practice, a significant improvement in back muscle function and a reduction in pain-related impairments have also been demonstrated.

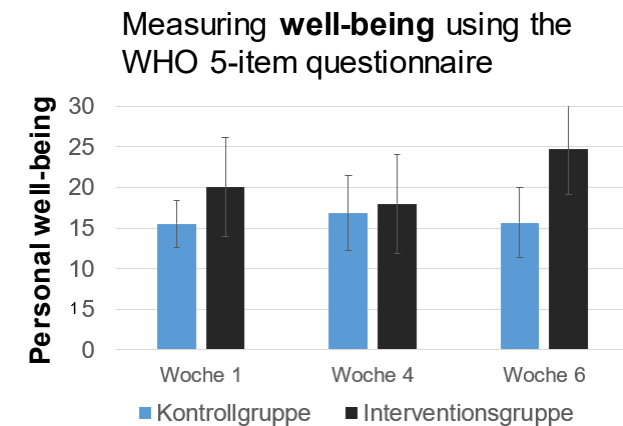


Fig.: Change in well-being during the intervention
(very good well-being starting at 19 points)



ICAROS

Studie H-VI

“VR exercise therapy for Post-COVID fatigue”

University of Heidelberg, 2025

Study VI

Goal: To determine whether immersive VR sports therapy is more effective than conventional exercise in reducing fatigue symptoms in post-COVID patients and is safe to use.

Sample:

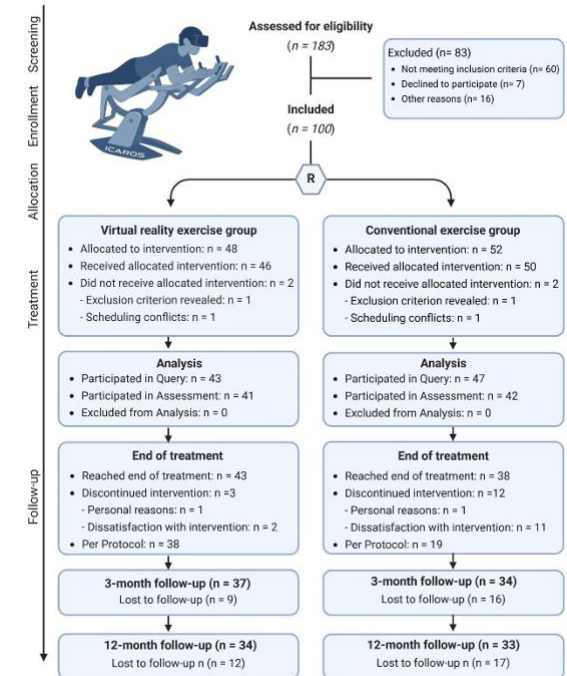
VR Group:	n= 46; 45,9 ± 11,8 years
control group: (Conventional training)	n= 50; 46,7 ± 11,4 years

Methods:

- **Design:** Double-blind, randomized controlled trial (RCT)
- **Intervention:** 6-week training program (12 sessions, 45 minutes each)
- **Measurement:** Comparison of fatigue scores (FSS) before and after treatment

Diagnostics:

- **FPI (Fatigue-PEM Index):** Measures exercise intolerance (deterioration in condition following activity)
- **6-Minute Walk Test (6MWT)**
- **Grip strength measurement:** Measures muscular fatigue
- **Cognitive tests (N-back/Stroop):** Measure concentration and attention (“brain fog”)
- **SF-12:** Assesses health-related quality of life



Study H-VI

Results:

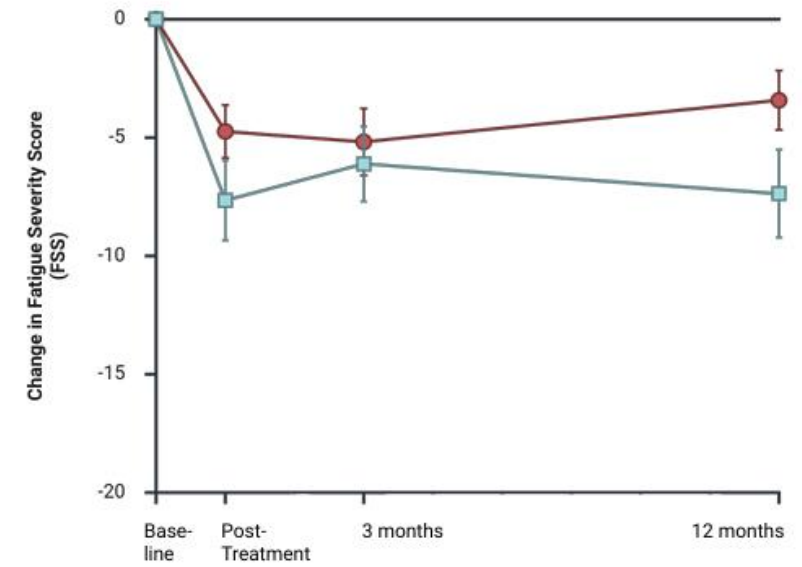
- **Fatigue severity** improved significantly in both groups, though without statistically significant differences between the groups
- Only the VR group achieved **clinical significance**
- Symptom worsening occurred less frequently in the VR group (9% vs. 22%)
- 76.7% of VR participants reported a **general improvement**, compared to 56.5% in the control group

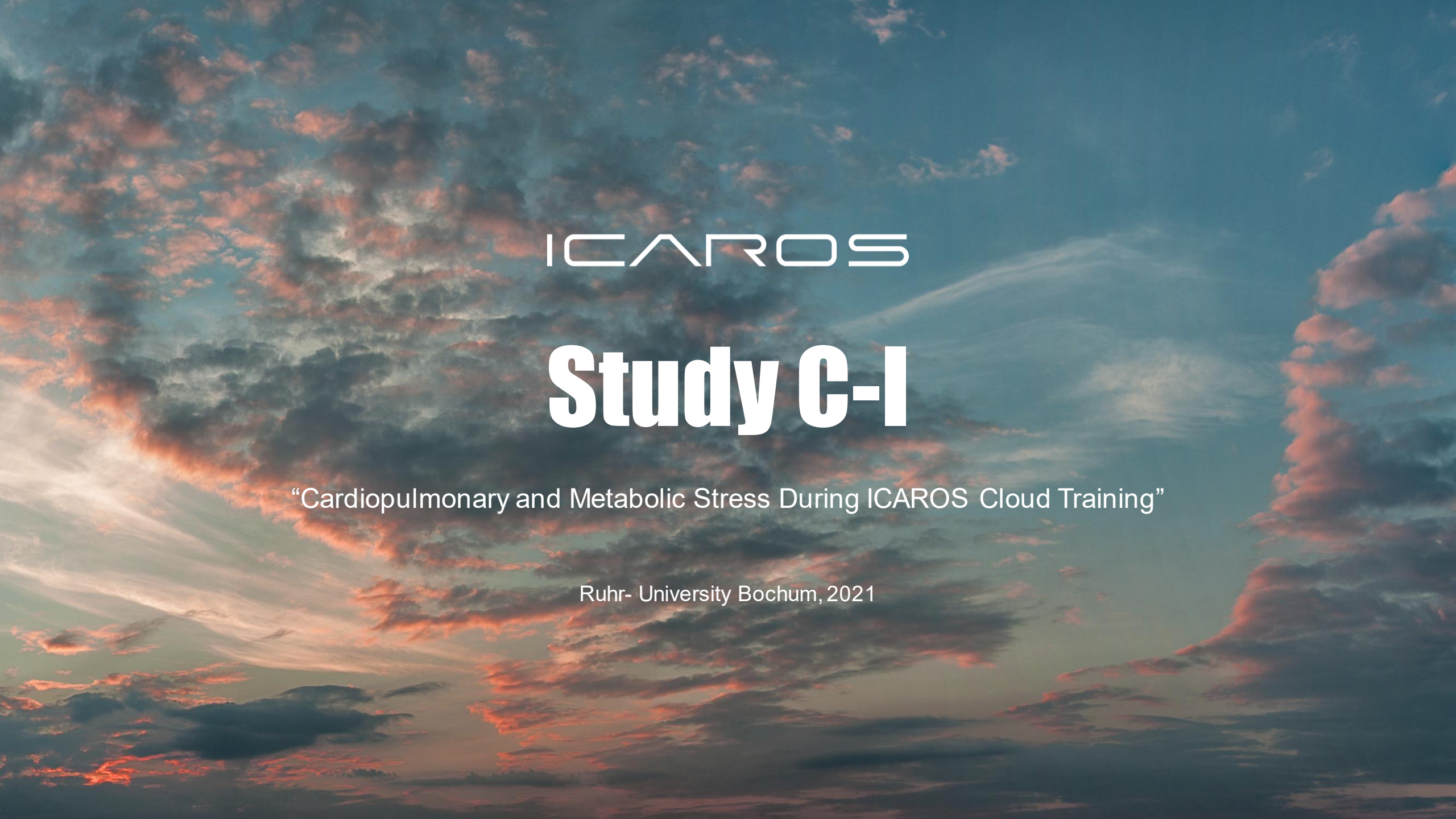
Conclusion:

Although VR therapy was not statistically more effective than conventional training, it proved to be a safe and clinically valuable alternative that resulted in a significant reduction in fatigue, higher patient satisfaction, and fewer instances of symptom exacerbation.

Published in:

TBC





ICAROS

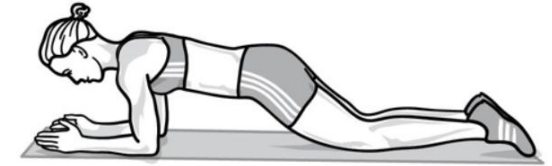
Study C-I

“Cardiopulmonary and Metabolic Stress During ICAROS Cloud Training”

Ruhr- University Bochum, 2021

Study C-I

- Goal:** Comparison of the differences between training on the ICAROS Cloud and training on a mat in terms of cardiopulmonary and metabolic parameters.
- Sample:** 16 participants, aged 24 ± 1.5 years
- Methods:** Randomized crossover design, comparison of two intervention conditions (training on ICAROS Cloud vs. training mat)
- Diagnostics:**
- Energy expenditure
 - Heart rate
 - Lactate concentration
 - Rated Perceived Exertion (RPE)
 - PACES questionnaire



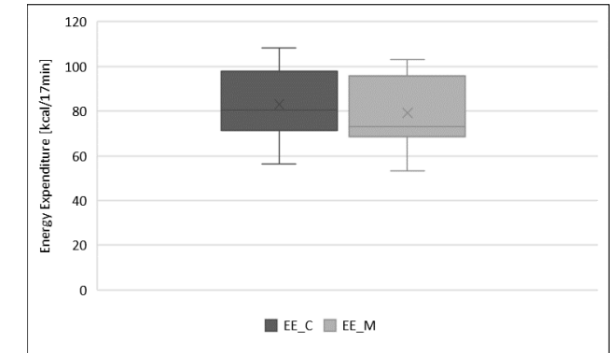
Study C-I

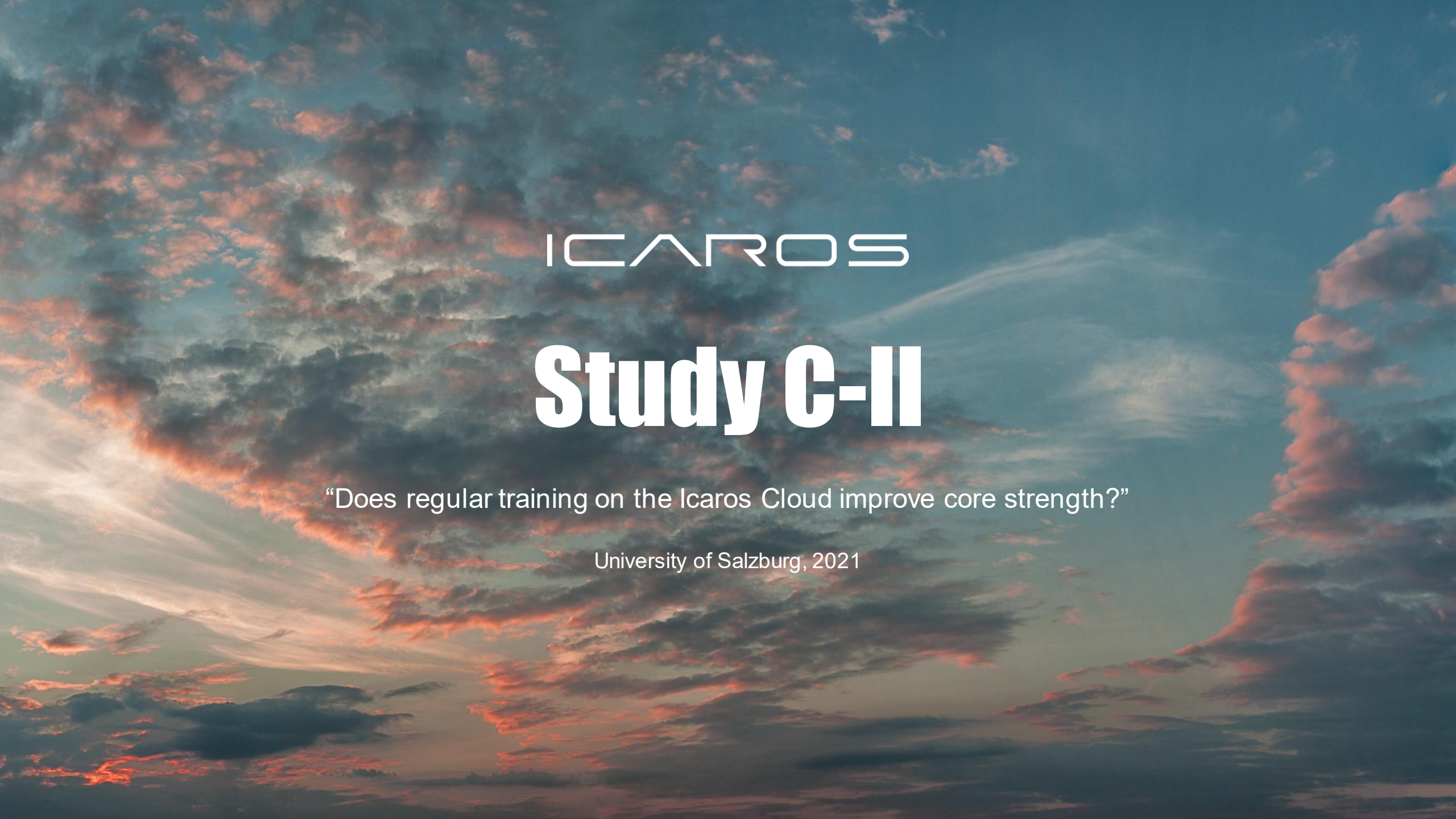
Results:

- 5% higher energy expenditure on the ICAROS Cloud compared to training on the mat
- No significant differences in heart rate
- Higher lactate concentration on the ICAROS Cloud
- No significant difference in perceived exertion as determined by the t-test
- Greater enjoyment when training on the ICAROS Cloud

Conclusion:

In a direct comparison with the mat, training on the ICAROS Cloud yielded higher physiological intensity levels, even though these were not statistically significant. The effective potential for increasing training intensity and quality stems primarily from the increased motivation to train





ICAROS

Study C-II

“Does regular training on the Icaros Cloud improve core strength?”

University of Salzburg, 2021

Study C-II

Goal:

Die Untersuchung analysiert, ob das Training auf der ICAROS Cloud zu einer Steigerung der Rumpfstärke sowie zu einer verbesserten Wahrnehmung von Spaß und Flow-Erleben führt.

Sample:

9 Probanden, Durchschnitt: 13 Jahre, weiblich

Methods:

- Pre-Test
- 3-wöchiges Training (2x pro Woche) auf der ICAROS Cloud für je 15min
- Post-Test

Diagnostics:

- Rumpfstärke (Zeit)
- Wahrgenommene Anstrengung (RPE)/ Borg Skala
- Flow-Zustand
- Spaß Faktor



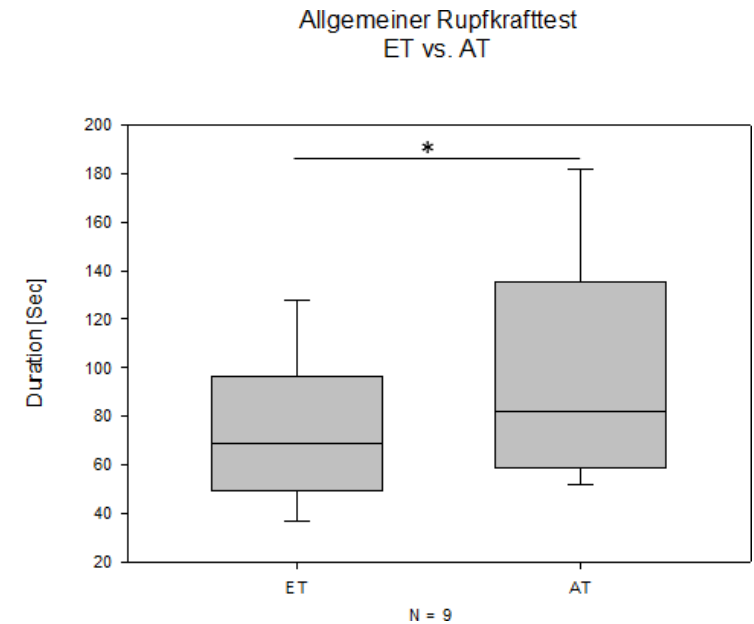
Study C-II

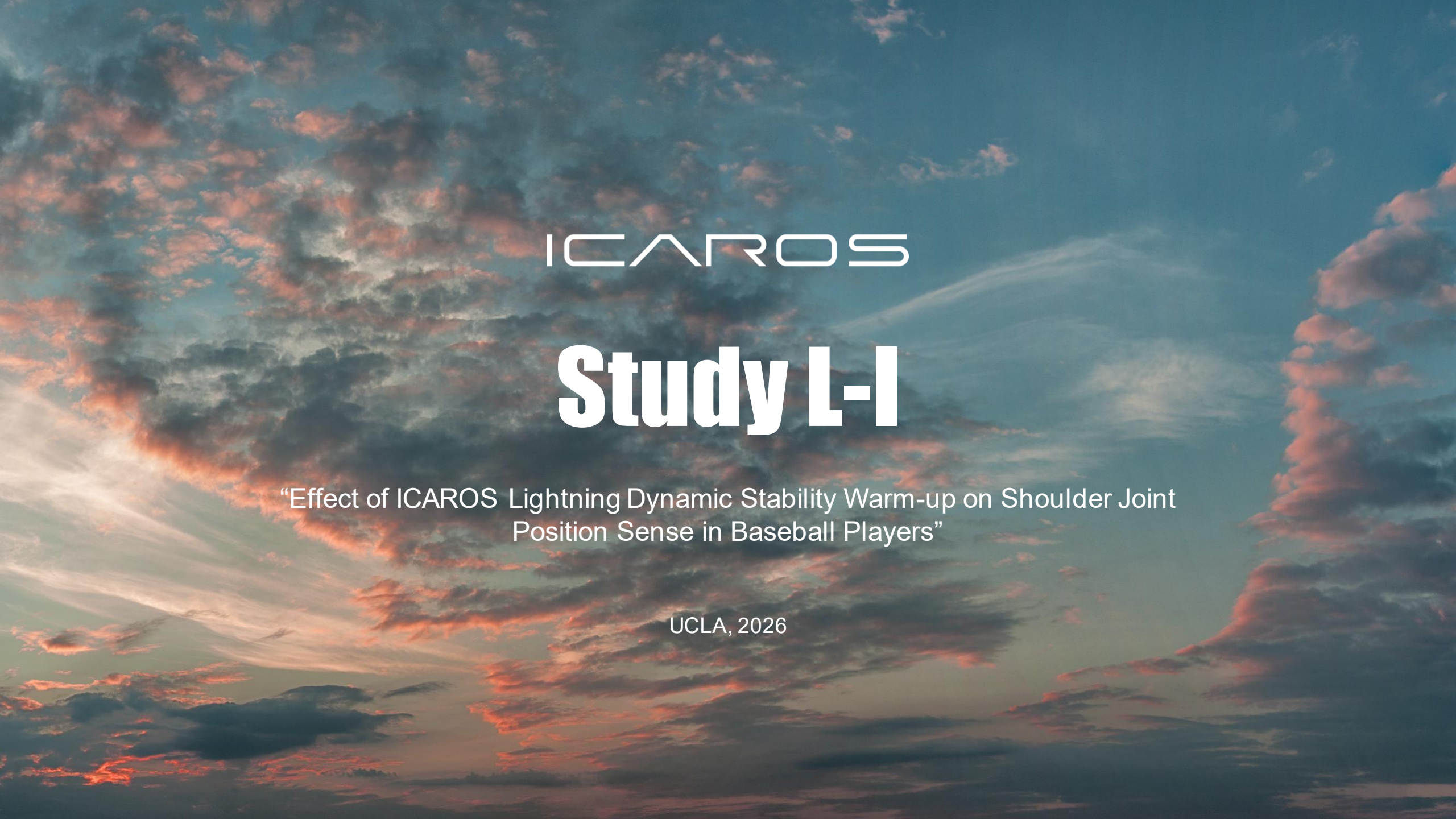
Results:

- Significant improvement in plank position (+15.85%)
- No significant differences in the subjective assessment of training intensity (BORG scale)
- Improvement in the core training program
- Increase in the number of push-ups per training session, with a moderate positive correlation of 0.620

Conclusion:

Training on the ICAROS Cloud resulted in a significant 15.85% increase in core strength and, thanks to its highly engaging nature, achieved a remarkable fun factor score of 8.11 out of 10. Based on these results, 90% of participants expressed a strong willingness to continue using the system and recommend it to others, underscoring its potential as a motivating and effective training tool.





ICAROS

Study L-I

“Effect of ICAROS Lightning Dynamic Stability Warm-up on Shoulder Joint
Position Sense in Baseball Players”

UCLA, 2026

Study L-I

Goal:

An evaluation of the ICAROS Lightning to improve **proprioceptive precision** and **shoulder joint position sense (SJPS)** in baseball players. An instability-based warm-up is intended to significantly reduce errors in **active joint position sense (AJPS)** during the pitch-specific cocking phase

Sample:

Methods:

- **Preparation:** Collection of general data
- **Pre-test:** Measurement of maximum rotation and active joint position sense
- **Intervention:** 3-minute training session on the ICAROS Lightning with maximum range of motion
- **Post-test:** Repeat of the AJPS test

Diagnostics:

Inclinometer: precise measurement of the angle of the shoulder joint

Laser positioning: ensuring consistent posture

InBody & stadiometer: body composition and height

Confidence scale: subjective confidence in movement