

A study of an AI-assisted multimodal assessment system for aerobic gymnastics training

Submission date 06/07/2026	Recruitment status No longer recruiting	<input type="checkbox"/> Prospectively registered <input type="checkbox"/> Protocol
Registration date 06/07/2026	Overall study status Completed	<input type="checkbox"/> Statistical analysis plan <input type="checkbox"/> Results
Last Edited 06/07/2026	Condition category Other	<input type="checkbox"/> Individual participant data <input checked="" type="checkbox"/> Record updated in last year

Plain English summary of protocol

Background and study aims

This study evaluated whether an artificial intelligence (AI)-assisted multimodal system can improve the assessment of aerobic gymnastics training. The aim was to determine whether an AI-based system integrating video analysis, motion capture, physiological signals, and psychological measures can provide more objective and accurate feedback on performance, fatigue, psychological readiness, and injury risk.

Who can participate?

Adults aged 18–30 years with at least 6 months of aerobic gymnastics experience, currently training at least twice per week, and with no recent musculoskeletal injury or serious medical conditions.

What does the study involve?

Participants were randomly allocated to either an AI-assisted feedback group or a conventional training/control group for a 12-week intervention. Both groups trained three times per week (60 minutes per session). The intervention group received multimodal AI-based feedback, while the control group received standard coaching feedback. Assessments were conducted at baseline, week 6, and week 12.

What are the possible benefits and risks of participating?

Participants may benefit from improved feedback on training quality and better monitoring of fatigue and injury risk. Risks are minimal and limited to normal exercise-related fatigue or minor musculoskeletal discomfort.

Where is the study run from?

The study is conducted collaboratively at Sejong University (South Korea) and Hanyang University (South Korea).

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

March 2024 to October 2024

Who is funding the study?
Investigator initiated and funded

Who is the main contact?
Gang Qin, qingang@hanyang.ac.kr

Contact information

Type(s)

Public, Scientific, Principal investigator

Contact name

Mr Gang Qin

ORCID ID

<https://orcid.org/0009-0000-4147-2870>

Contact details

Seoul

Seoul

Thailand

04763

+66 (0)1056135210

qingang@hanyang.ac.kr

Additional identifiers

Study information

Scientific Title

Development and validation of an AI-driven multimodal system for assessing aerobic gymnastics training using video analysis, motion capture, and physiological signals

Acronym

AIM-AerobicGym

Study objectives

To develop and validate an AI-driven multimodal assessment system for aerobic gymnastics training by integrating video analysis, motion capture, physiological signals, cognitive tracking, and psychological measures, and to evaluate its accuracy, feasibility, and usefulness for assessing performance, fatigue, psychological readiness, and injury risk.

Ethics approval required

Ethics approval required

Ethics approval(s)

Approved 28/02/2024, Ethics Committee of the School of Physical Education, Shandong Normal University (School of Physical Education, Shandong Normal University, Jinan, 250014, China; +86 (0)1056135210; qingang@hanyang.ac.kr), ref: SDNUTYDW2024019

Primary study design

Interventional

Allocation

Randomized controlled trial

Masking

Blinded (masking used)

Control

Active

Assignment

Parallel

Purpose

Device feasibility

Study type(s)**Health condition(s) or problem(s) studied**

Aerobic gymnastics training performance, fatigue, psychological readiness, and injury risk assessment

Interventions

Participants were randomly assigned to either an AI-assisted feedback group or a conventional training/control group for 12 weeks using a computer-generated randomisation sequence. The sequence was generated by an independent researcher who was not involved in recruitment, assessment, or intervention delivery. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes (SNOSE). Participants were assigned in a 1:1 allocation ratio.

Both groups completed aerobic gymnastics training three times per week, 60 minutes per session. The AI-assisted group received multimodal feedback based on video analysis, motion capture, physiological monitoring, cognitive tracking, and psychological assessment. The control group received standard coaching and evaluator-based feedback.

Intervention Type

Device

Phase

Not Applicable

Drug/device/biological/vaccine name(s)

AI-driven multimodal assessment system for aerobic gymnastics training

Primary outcome(s)

1. AI model accuracy for aerobic gymnastics performance assessment measured using classification accuracy of the AI-driven multimodal system compared with certified evaluator ratings using multimodal data from video analysis, motion capture, physiological monitoring, cognitive tracking, and psychological assessment, at baseline, week 6, and week 12

Key secondary outcome(s)

1. Movement quality measured using AI-generated performance scores and certified evaluator ratings based on standardized aerobic gymnastics scoring procedures at baseline, week 6, and week 12

Completion date

01/10/2024

Eligibility

Key inclusion criteria

1. Adults aged 18–30 years
2. At least 6 months of aerobic gymnastics experience
3. Active training at least twice per week
4. No musculoskeletal injury within the past 3 months
5. Able to complete the 12-week training protocol
6. Provided written informed consent

Healthy volunteers allowed

Yes

Age group

Adult

Lower age limit

18 Years

Upper age limit

30 Years

Sex

All

Total final enrolment

600

Key exclusion criteria

1. Cardiovascular disease
2. Recent surgery
3. Musculoskeletal injury within the past 3 months
4. Inability to complete the 12-week training protocol
5. Inability or unwillingness to provide written informed consent

Date of first enrolment

01/03/2024

Date of final enrolment

30/05/2024

Locations**Countries of recruitment**

China

Korea, South

Sponsor information**Organisation**

Hanyang University

ROR

<https://ror.org/046865y68>

Funder(s)**Funder type****Funder Name**

Investigator initiated and funded

Results and Publications**Individual participant data (IPD) sharing plan****IPD sharing plan summary**

Not expected to be made available