ISRCTN14809597 https://doi.org/10.1186/ISRCTN14809597

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

Submission date
06/07/2026

Recruitment status
No longer recruiting

Registration date
06/07/2026

Overall study status
Completed

Last Edited
14/07/2026

Condition category
Other

[_] Prospectively registered
[_] Protocol
[_] Statistical analysis plan
[X] Results
[_] Individual participant data

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

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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

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		10/07/2026	14/07/2026	Yes	No