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Wearable device-based short exercise breaks for improving activity patterns and body composition in adolescents with obesity

Submission date
27/06/2026

Recruitment status
No longer recruiting

Registration date
30/06/2026

Overall study status
Completed

Last Edited
29/06/2026

Condition category
Nutritional, Metabolic, Endocrine

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
Adolescent obesity is an important public health problem. Many adolescents find it difficult to complete long structured exercise sessions because of school schedules, limited time, low motivation, or limited access to exercise facilities. Exercise snacking is an alternative approach in which short bouts of physical activity are performed several times during the day. This study aims to assess whether wearable device-supported exercise snacking can improve daily activity patterns, body composition, physical activity, metabolic health, and psychological outcomes in adolescents with obesity.

Who can participate?
Adolescents aged 12–16 years with obesity can participate. Obesity is defined as BMI at or above the 95th percentile for age and sex. Participants must have stable school enrolment, no systematic exercise programme in the previous 6 months, and no diagnosed metabolic, cardiovascular, or neurological disorders. Written informed consent from a parent or legal guardian and written assent from the adolescent are required.

What does the study involve?
A total of 120 adolescents are randomly allocated to one of three groups. The first group receives wearable device-based exercise snacking with real-time feedback and prompts. The second group performs the same exercise snacking programme but without wearable feedback or prompts. The third group receives health education only. The active intervention lasts 12 weeks, followed by a 12-week no-contact follow-up period. The exercise snacking programme consists of brief body-weight or stepping-based activities lasting 1–3 minutes per bout, performed 5–8 times per day. Study outcomes are assessed at baseline, week 6, week 12, and week 24.

What are the possible benefits and risks of participating?
Participants may benefit from increased physical activity, improved daily activity patterns, better body composition, and improved awareness of healthy lifestyle behaviours. The risks are expected to be low. Possible risks include temporary tiredness, muscle soreness, minor

discomfort during exercise, or discomfort from wearing monitoring devices. Participants are monitored during the study, and any adverse events are recorded.

Where is the study run from?
Shandong Sport University (China)

When is the study starting and how long is it expected to run for?
September 2025 to June 2026

Who is funding the study?
Investigator initiated and funded

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

Contact information

Type(s)
Public, Scientific, Principal investigator

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Study information

Scientific Title
Effects of a wearable device-based exercise snacking intervention on daily activity fragmentation and body composition in adolescents with obesity: a randomized controlled trial

Study objectives

Ethics approval required
Ethics approval required

Ethics approval(s)

Approved 25/12/2024, Ethics Committee of Sport Science of Shandong Sport University (Shandong Sport University, No. 399 Shandong Road, Rizhao, 276826, China; +86 (0) 13563345184; houyun@sdpei.edu.cn), ref: 2024083

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Open (masking not used)

Control
Active

Assignment
Parallel

Purpose
Prevention

Study type(s)

Health condition(s) or problem(s) studied
Adolescent obesity and related body composition, physical activity, and metabolic health outcomes

Interventions
This is a three-arm randomized controlled trial involving adolescents aged 12–16 years with obesity. After completion of baseline assessment, eligible participants were randomly allocated in a 1:1:1 ratio to one of the following three groups: wearable device-based exercise snacking with real-time feedback, exercise snacking without feedback, or health education control. The randomisation sequence was generated by computer using permuted blocks with a block size of 6. Randomisation was stratified by sex and baseline BMI category to help ensure balanced allocation across groups. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes prepared by an independent statistician who was not involved in participant recruitment, intervention delivery, or outcome assessment.

The active intervention lasted 12 weeks, followed by a 12-week no-contact follow-up period. Participants in the two exercise snacking groups performed brief bouts of body-weight or stepping-based activity lasting 1–3 minutes per bout, 5–8 bouts per day.

Intervention Type
Behavioural

Primary outcome(s)
1. Activity Fragmentation Index measured using the number of active-to-sedentary transitions per waking hour using ActiGraph GT9X accelerometer data processed with the GGIR package at baseline, week 6, week 12, and week 24

Key secondary outcome(s)

1. Moderate-to-vigorous physical activity is measured as minutes per day using ActiGraph GT9X accelerometer data processed with the GGIR package at baseline, week 6, week 12, and week 24.
2. Daily step count is measured using ActiGraph GT9X accelerometer data processed with the GGIR package at baseline, week 6, week 12, and week 24.
3. Sedentary time is measured as minutes per day using ActiGraph GT9X accelerometer data processed with the GGIR package at baseline, week 6, week 12, and week 24.
4. Body fat percentage is measured using dual-energy X-ray absorptiometry at baseline, week 12, and week 24.
5. Fat-free mass is measured using dual-energy X-ray absorptiometry at baseline, week 12, and week 24.
6. BMI percentile is calculated from measured height and body mass using WHO age- and sex-specific growth references at baseline, week 12, and week 24.
7. Waist-to-hip ratio is measured using an anthropometric tape at baseline, week 12, and week 24.
8. Resting metabolic rate is measured using indirect calorimetry with the Cosmed Quark CPET system at baseline, week 12, and week 24.
9. Respiratory exchange ratio is measured using indirect calorimetry with the Cosmed Quark CPET system at baseline, week 12, and week 24.
10. Heart rate variability, including SDNN and RMSSD, is measured using a Polar H10 heart rate monitor and Kubios HRV software at baseline, week 6, week 12, and week 24.
11. Resting heart rate is measured using a Polar H10 heart rate monitor at baseline, week 6, week 12, and week 24.
12. Fasting glucose is measured from fasting venous blood samples using the hexokinase method at baseline, week 12, and week 24.
13. Fasting insulin is measured from fasting venous blood samples using chemiluminescent immunoassay at baseline, week 12, and week 24.
14. Insulin resistance is measured using the homeostatic model assessment of insulin resistance, calculated from fasting glucose and fasting insulin, at baseline, week 12, and week 24.
15. Adiponectin is measured from fasting venous blood samples using enzyme-linked immunosorbent assay at baseline, week 12, and week 24.
16. Exercise motivation is measured using the Behavioral Regulation in Exercise Questionnaire-3 at baseline, week 6, week 12, and week 24.
17. Subjective well-being is measured using the World Health Organization Five Well-Being Index at baseline, week 6, week 12, and week 24.
18. Perceived exertion is measured using the Borg Rating of Perceived Exertion scale in the two exercise snacking groups at week 6 and week 12.
19. Intervention adherence is measured using automated app-recorded exercise completion rates in the wearable feedback group and weekly exercise logs in the exercise snacking without feedback group at week 6 and week 12.
20. Device wear time is measured using ActiGraph GT9X accelerometer data at baseline, week 6, week 12, and week 24.

Completion date

01/06/2026

Eligibility

Key inclusion criteria

1. Adolescents aged 12–16 years
2. BMI at or above the 95th percentile for age and sex according to WHO growth reference standards
3. Had not participated in a systematic exercise program within the preceding 6 months
4. Had stable school enrollment
5. Had no diagnosed metabolic, cardiovascular, or neurological disorders
6. Provided written assent with written informed consent from a parent or legal guardian

Healthy volunteers allowed
No

Age group
Child

Lower age limit
12 Years

Upper age limit
16 Years

Sex
All

Total final enrolment
120

Key exclusion criteria
1. Currently using medications affecting metabolism or body composition, such as corticosteroids, thyroid hormones, or weight-loss pharmacotherapy
2. Diagnosed psychiatric conditions that could impair protocol adherence
3. Unable or unwilling to wear monitoring devices
4. Participating in concurrent weight-management programs
5. Metabolic, cardiovascular, or neurological disorders
6. Exercise contraindications
7. Judged during screening to have anticipated poor compliance

Date of first enrolment
01/09/2025

Date of final enrolment
31/12/2025

Locations

Countries of recruitment
China

Sponsor information

Organisation
Shandong Sport University

ROR
https://ror.org/026b4k258

Funder(s)

Funder type

Funder Name
Investigator initiated and funded

Results and Publications

Individual participant data (IPD) sharing plan
De-identified individual participant data supporting the main study findings will be made available upon reasonable request after publication of the main results. Data will be shared only after approval by the study investigators and in accordance with ethics approval, participant consent, and applicable data protection requirements.

IPD sharing plan summary
Available on request