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Effects of interrupting sitting on glycemic control

Submission date	Recruitment status
04/07/2023	No longer recruiting
Registration date	**Overall study status**
05/07/2023	Completed
Last Edited	**Condition category**
14/07/2025	Nutritional, Metabolic, Endocrine

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

Plain English summary of protocol
Background and study aims
The sedentary (inactive) lifestyle, which is highly associated with heart disease and type 2 diabetes, has become highly prevalent in the last decade. Breaking up prolonged sitting time with physical activities has been proven to be beneficial for postprandial (after meals) glucose response. The specific pattern (intensity, frequency, and modality) still remains to be determined. The aim of this study is to examine the effects of breaking up sitting time with brief bouts or a single bout of activities, all having a unique muscle activity pattern but similar energy expenditure, on postprandial glucose responses in overweight and obese men.

Who can participate:
Healthy Chinese young adults between 18-25 years old with body mass index (BMI) over 24 kg /m2

What does the study involve?
Participants are randomly allocated to prolonged sitting for 8.5 hours, sitting with 30-min walking, sitting with 3-min walking every 45 min, or sitting with 3-min squatting every 45 min. Participants undergo glucose and leg muscle activity measurements.

What are the possible benefits and risks of participating?
The benefits are that participants can understand their glucose metabolism and were given an individualized sedentary break program. The risks are participants may be afraid to wear a continuous glucose monitor.

Where is the study run from?
Zhejiang University (China)

When is the study starting and how long is it expected to run for?
April 2020 to August 2021

Who is funding the study?
National Natural Science Foundation of China

Who is the main contact?
Dr Ying Gao, yigao@zju.edu.cn

Contact information

Type(s)
Scientific

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Additional identifiers

Clinical Trials Information System (CTIS)
Nil known

ClinicalTrials.gov (NCT)
Nil known

Protocol serial number
Nil known

Study information

Scientific Title
Muscle activity when interrupting prolonged sitting improves glycemic control in overweight and obese men

Study objectives
Breaking up prolonged sitting time with physical activities would attenuate postprandial glucose response. Multiple breaks would elicit more pronounced glucose reduction through greater muscle activity.

Ethics approval required
Ethics approval required

Ethics approval(s)
approved 02/06/2020, Medical Ethics Committee of Zhejiang University (866 Yuhangtang Rd, Hangzhou, 310058, China; +86 (0)15967119137; medicalethics@zju.edu.cn), ref: No.2020–099

Study design
Randomized four-arm crossover study

Primary study design
Interventional

Study type(s)
Prevention

Health condition(s) or problem(s) studied
Prevention of pre-diabetes in overweight and obese adults

Interventions
The randomization sequence was generated with an online statistical package (https://www.randomization.com). Participants were blinded to the order of the conditions until the commencement of each condition.

SIT. Participants sat upright in a comfortable chair throughout the 8.5-h measurement and were instructed to minimize excessive movement.

ONE. The protocol was identical to SIT, but participants performed a 30-min light-intensity walking on a treadmill at 4 km·h-1 with no gradient at 1:00 of the experiment time. The first bout commenced at 1:00 of the experiment time.

WALK. The protocol was identical to SIT, but participants performed 3-min bouts of light-intensity walking on a treadmill at the same speed and gradient as ONE every 45 min, 10 times throughout the day, which accumulated a total of 30 min walking. The first bout commenced at 1:00 of the experiment time.

SQUAT. The protocol was identical to SIT, but participants performed 3-min bouts of squatting following a soundtrack every 45 min, 10 times throughout the day, which accumulated a total of 30 min activity. The soundtrack would beep every 5 seconds.

Intervention Type
Behavioural

Primary outcome(s)
Postprandial glucose measured using a continuous glucose monitor (CGM) throughout the 8.5-h intervention

Key secondary outcome(s))
1. Muscle activity measured using textile EMG shorts throughout the 8.5-h intervention
2. Heart rate measured using a heart rate belt throughout the 8.5-h intervention
3. Physical activity measured using accelerometry 2 days before each condition
4. Food intake measured using self-reported dialogue 2 days before each condition
5. Blood pressure measured using an electronic blood pressure monitor every 45 minutes during the measurement (beginning, 1:00, 1:45, 2:30, 3:15, 4:00, 4:45, 5:30, 6:15, 7:00, 7:45, and 8:30 of the experiment time)
6. Perceived feelings, including shoulder, upper limbs, waist, hip, and lower limbs discomfort, fatigue, and working efficiency, measured using a visual analogue scale every 45 minutes during the measurement (beginning, 1:00, 1:45, 2:30, 3:15, 4:00, 4:45, 5:30, 6:15, 7:00, 7:45, and 8:30 of

the experiment time)
7. Energy expenditure of daily physical activity tasks, including supine, sitting, standing, walking, running, and squatting, measured using K5 indirect calorimetry 1 week before the intervention
8. Body composition, including body mass, fat mass, muscle mass, and liver fat index, measured using a bioelectrical impedance device 1 week before the intervention
9. Leg swelling measured using a self-made water tank (water displacement method) before and after each condition

Completion date
30/08/2021

Eligibility

Key inclusion criteria
1. Healthy Chinese men aged 18-35 years old
2. Overweight or obese (BMI ≥24 kg/m2)
3. Sedentary (self-reported sitting time >6 h per day for last 2 months), physically inactive (not meeting the physical activity guideline of ≥150 min per week of moderate-intensity or ≥75 min per week of vigorous-intensity exercise for last 2 months)
4. Free of diabetes and cardiovascular diseases (fasting glucose ≤6.1 mmol/l) and nonsmoker

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 years

Upper age limit
35 years

Sex
Male

Key exclusion criteria
1. Self-reported chronic, long-term musculoskeletal disease
2. Cardiovascular or metabolic disease requiring medication known to affect metabolism
3. Change of body weight >2 kg in the past 2 months

Date of first enrolment
01/11/2020

Date of final enrolment
30/08/2021

Locations

Countries of recruitment
China

Study participating centre
Zhejiang University
Number 866
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Sponsor information

Organisation
Zhejiang University

ROR
https://ror.org/00a2xv884

Funder(s)

Funder type
Government

Funder Name
National Natural Science Foundation of China

Alternative Name(s)
Chinese National Science Foundation, Natural Science Foundation of China, National Science Foundation of China, NNSF of China, NSF of China, National Nature Science Foundation of China, Guójiā Zìrán Kēxué Jījīn Wěiyuánhuì, , NSFC, NNSF, NNSFC

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location

China

Results and Publications

Individual participant data (IPD) sharing plan

The datasets generated and/or analysed during the current study will be published as a supplement to the results publication

IPD sharing plan summary

Published as a supplement to the results publication

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		12/07/2025	14/07/2025	Yes	No
Participant information sheet	Participant information sheet	11/11/2025	11/11/2025	No	Yes