

Carryover effects in melatonin suppression

Submission date 20/06/2025	Recruitment status No longer recruiting	☐ Prospectively registered ☒ Protocol
Registration date 30/06/2025	Overall study status Completed	☐ Statistical analysis plan ☐ Results
Last Edited 27/08/2025	Condition category Other	☐ Individual participant data ☐ Record updated in last year

Plain English summary of protocol

Background and study aims

Exposure to light in the evening or at night can reduce how much melatonin your body produces. Melatonin is a hormone that helps you feel sleepy. Evening light can also shift your body clock, making it harder to fall asleep and possibly affecting your sleep quality. However, we still don't fully understand how melatonin levels vary from day to day, or how light exposure on the days before affects this.

This study aims to learn how different levels of evening light affect the body and behaviour. We are studying this in healthy adults between 18 and 40 years old.

Who can participate?

Healthy adults aged 18 to 40 years who are in good physical and mental health and have healthy vision can participate. Participants can be men, women with a natural menstrual cycle, or women who take a specific type of birth control pill.

What does the study involve?

Each participant goes through all parts of the study and serves as their own control. The study has three parts:

Week at home – Participants follow their usual routine for one week while we record their sleep, physical activity, light exposure, and glucose levels.

Ten days in the laboratory – Participants come to the laboratory for six hours each evening. They are exposed to different light levels (dim or bright light). We collect saliva samples every 30 minutes to measure melatonin. Participants also complete short questionnaires every 30 minutes about how sleepy they feel and how comfortable they find the room temperature. Every hour, they take a short attention test. We also measure their skin and core body temperature during the laboratory visits.

Week at home again – After the laboratory period, participants return to their normal routine for one more week while we continue to collect data.

What are the possible benefits and risks of participating?

Participants will receive personal health feedback, including insights into their sleep and glucose patterns. They will receive EUR540 for completing the full study.

There are no major medical risks. However, some people may feel tired from the laboratory visits. The glucose sensor may also cause mild skin irritation.

Where is the study run from?

The study is run by the Technical University of Munich, in collaboration with the Professorship for Chronobiology and Health and the Chair for Engineering and Design.

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

The study was planned in January 2025. Recruitment started in May 2025, after ethics approval. We expect to complete the last experiments by August 2025.

Who is funding the study?

This work is funded by internal sources and by the TUM Institute for Advanced Study (IAS), Focus Group Human-Centric Building Performance (Germany)

Who is the main contact?

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Contact information

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Study information

Scientific Title

Carryover effects in melatonin suppression during repeated light exposure in healthy adults: a within-subject controlled trial

Acronym

AFTERGLOW

Study objectives

Primary hypotheses:

H1: Light exposure (1000 lx) leads to greater melatonin suppression compared to dim light (10 lx).

H2: The impact of light exposure on melatonin suppression is modulated by prior light history.

H3: Individual variability in melatonin suppression is significant.

Secondary hypotheses:

H4: Bright light exposure reduces subjective sleepiness compared to dim light.

H5: Bright light exposure enhances psychomotor vigilance.

H6: Core body temperature follows a different trajectory under bright vs. dim light.

H7: Distal-proximal skin temperature gradient follows a different trajectory under bright vs. dim light.

H8: Bright light exposure influences glucose metabolism.

Ethics approval required

Ethics approval required

Ethics approval(s)

Approved 07/05/2025, Ethics Committee at the Technical University of Munich (Grillparzerstraße 16, Munich, 81675, Germany; +49 89 4140-7737; ethikkommission@mri.tum.de), ref: 2025-164-S-SB

Primary study design

Interventional

Study design

Interventional randomized cross over trial

Study type(s)

Other, Prevention, Quality of life

Health condition(s) or problem(s) studied

Chronobiology, melatonin suppression

Interventions

This ten-day in-laboratory within-subject study in healthy adults aged 18-40 years examines melatonin suppression and potential carryover effects of repeated evening light exposure (dim light 10 lx, bright light 1000 lx), with light exposure sequence determined by a 2-label, 3-level counterbalanced De Bruijn sequence with no masking applied.

After successful screening, participants are invited to visit the laboratory to sign the informed consent and collect the study devices. They will begin with a 7-day ambulatory pre-laboratory period, during which they follow their regular routines while wearing an ActiGraph (to monitor physical activity and sleep), an ActLumus (to measure light exposure), and a continuous glucose monitor (CGM) for interstitial glucose levels. During this period, participants complete a daily sleep questionnaire each morning upon waking and roughly record their food and drink intake as well as physical activity. This is followed by a 10-day sequential laboratory stay. Participants arrive at the laboratory 6.5 hours before their habitual bedtime, where they receive a standardized meal tailored to their anthropometric measurements. After a 60-minute rest, they spend 3 hours in dim light conditions (10 lx), followed by a 1.5-hour exposure period to either 10 lx or 1000 lx lighting. Skin and core body temperature are continuously measured throughout the laboratory stay. Participants leave the laboratory 30 minutes before their habitual bedtime. To address potential evening hunger, an optional snack is provided for the way home. This is intended to prevent compensatory overeating later in the evening, which could negatively impact sleep onset and overall sleep quality. During the laboratory stay, saliva samples are collected every 30 minutes to assess melatonin levels. Every 30 minutes, participants complete sleepiness and visual comfort questionnaires, and every 60 minutes, they perform a psychomotor vigilance test (PVT). The laboratory period is concluded by a final 7-day post-laboratory period at home.

Intervention Type

Mixed

Primary outcome(s)

Melatonin concentrations (pg/mL) are determined from saliva samples collected at 30-minute intervals throughout each of the ten evenings in the laboratory.

Key secondary outcome(s)

1. Subjective sleepiness measured using Karolinska Sleepiness Scale (KSS) scores at 30-minute intervals throughout each of the ten evenings in the laboratory.
2. Reaction time (ms) measured using the psychomotor vigilance test (PVT) at 60-minute intervals throughout each of the ten evenings in the laboratory.
3. Core body temperature measured continuously during each of the ten evenings in the laboratory using indigestible pills by BodyCap.
4. Skin temperature measured continuously during each of the ten evenings in the laboratory using iButtons attached to the ankle (distal) and neck (proximal).
5. Interstitial glucose levels measuring using the continuous glucose monitor during the ambulatory pre-laboratory, laboratory and post-laboratory period.

Completion date

31/08/2025

Eligibility

Key inclusion criteria

1. Age: $\geq 18, \leq 40$ years of age
2. Biological sex: men / women with a natural menstrual cycle / women taking monophasic combined oral contraceptives
3. Good physical health
4. Good mental health
5. Good ocular health
6. Normal color vision
7. Ability to comprehend and communicate in basic English

Participant type(s)

Healthy volunteer, Learner/student

Healthy volunteers allowed

No

Age group

Adult

Lower age limit

18 Years

Upper age limit

40 Years

Sex

All

Total final enrolment

9

Key exclusion criteria

1. Biological sex: women taking any other type of hormonal contraception
2. BMI: <18 / >30 years
3. Any use of medications
4. Habitual smoking
5. Diagnosis of epilepsy
6. Excessive alcohol use
7. Poor sleep quality
8. Extreme chronotype
9. Shift work in the past 3 months
10. Inter-time zone travel in the past 3 months
11. Currently pregnant and <12 months postpartum
12. Any hormonal imbalances
13. Any drug detected
14. Any alcohol in breath

Date of first enrolment

12/05/2025

Date of final enrolment

30/06/2025

Locations

Countries of recruitment

Germany

Study participating centre

University (TUM SenseLab)

Arcisstr. 21

Munich

Germany

80333

Sponsor information

Organisation

Technical University of Munich Professorship for Chronobiology and Health

Funder(s)

Funder type

Other

Funder Name

Investigator initiated and funded

Results and Publications

Individual participant data (IPD) sharing plan

All data to be published will be stored in anonymized form in the Professorship's GitHub repository at github.com/tscnlab. Data will be available under an open licence, and after informed consent is obtained from participants. A permalink will be generated on Zenodo, and this information updated here.

IPD sharing plan summary

Stored in publicly available repository

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Participant information sheet			30/06/2025	No	Yes
Protocol file			30/06/2025	No	No