Does low-intensity artificial light at night (low-LAN) affect glucose in humans?

Ni TANG[1], Abhishek S. PRAYAG[1], Yanlong HOU[1], Xi WANG[1,2], Lydie MERLE[1], Anissa DAHMANI, Tao JIANG[2], Claude GRONFIER[1]

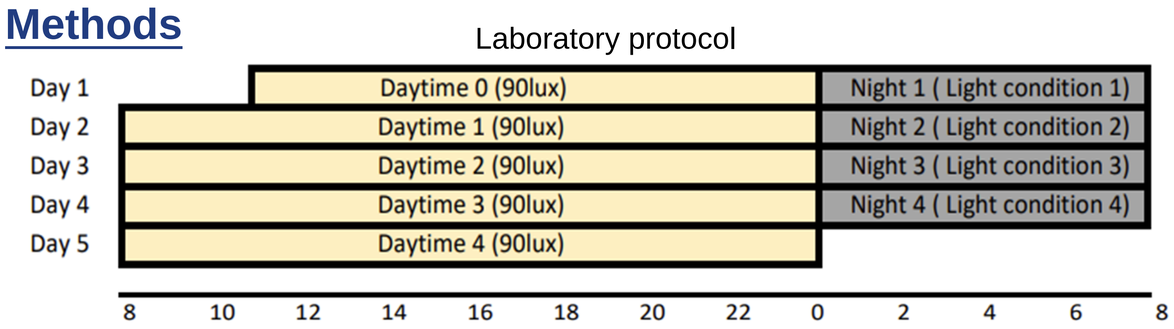
1.Lyon Neuroscience Research Center (CRNL), Neurocampus, Waking Team, Inserm UMRS 1028, CNRS UMR 5292, Université Claude Bernard Lyon 1, Université de Lyon, 69000, Lyon, France; 2.Lyon Neuroscience Research Center (CRNL), Neurocampus, ENES Team, Inserm UMRS 1028, CNRS UMR 5292, Université Claude Bernard Lyon 1, Université de Lyon, 69000, Lyon, France

eSLEEP EUROPE
October 4-6, 2023 | Virtual Congress

Introduction

- Exposure to artificial light at night is widespread around the world (Kyba CCM, et al.2023).
- Light entrains the circadian systems and modulates sleep regulation via intrinsically photosensitive ganglion cells (ipRGC) (Morin L.P, et al. 2015).
- Circadian and sleep processes coordinate daily physiological functions, including metabolic regulation (Poggiogalle E, et al. 2018).
- Our laboratory studies have showed that the effects of light on human physiology can be observed at very low light intensities and short durations (Prayag AS et al 2019a, 2019b).
- But it's still unclear whether low-intensity light at night (low-LAN) can impact sleep and physiological functions.

Methods



- **Participants**

Twenty healthy male volunteers were recruited. Inclusion criteria were good sleep quality (PSQI score ≤5), no extreme chronotypes (Horne and Ostberg score between 42 and 58), no shift work nor transmeridian travel during the past 3 months, and a stable sleep-wake cycle (social jet-lag ≤2 h), and no evidence of pathology, psychiatric and sleep disorders and visual dysfunctions.

- **Protocol**

The participants followed a laboratory protocol of 5 days and 4 nights in time isolation conditions. During their 8-h sleep opportunities at their usual sleep schedules, participants were randomly assigned to one of 4 light conditions: 0 lux, 3 lux, 8 lux, or 20 lux.

- **Polysomnography** (PSG)

During each 8 h sleep episode, sleep was recorded by PSG (Vitaport, TEMEC).

- **Glucose**

Participants wore Continuous Glucose Monitoring (CGM) systems (FreeStyle Libre 2, Abbott) during the 5 study days, and interstitial glucose concentrations were automatically collected at 15 min intervals, day and night.

Subjects	20 males
Age (years)	24.2 ± 3.3
BMI (kg/m2)	22.2 ± 2.2
PSQI	3.2 ± 1.5
Bed time	23 : 01
Wake time	07 : 23
Midsleep	03 : 02
Sleep duration (hours)	08 : 00

Results

Result 1: Effects of light at night on nocturnal glycemia

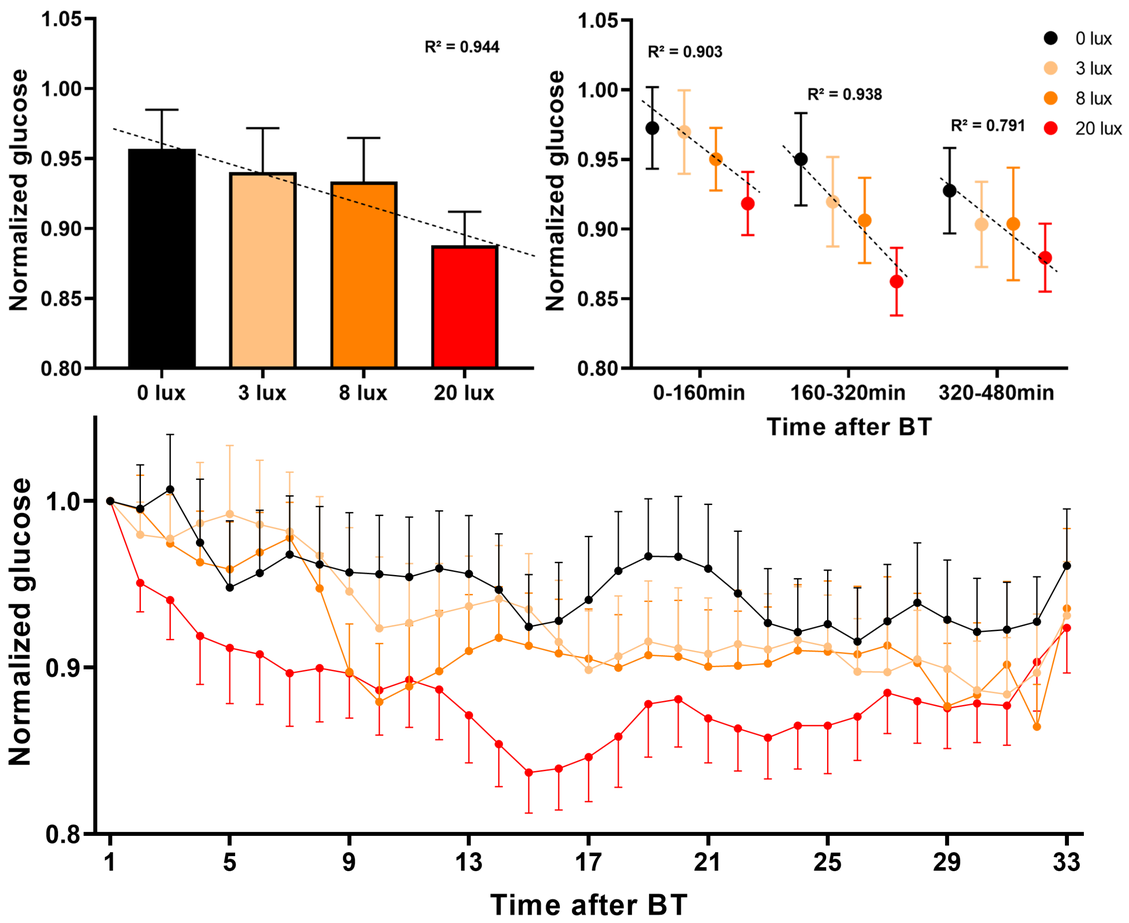


Figure 1: Effects of light at night on nocturnal glycemia (N=20). *Top left:* Average normalized glucose during nighttime under four light conditions at night. We found a strong negative correlation between normalized glucose and light conditions. *Top right:* Average normalized glucose during each third of night under four light conditions during night. There is a moderate to large effect size of 0lux and 20lux on glycemia during the middle third of the night (d=0.49). *Bottom*: Variation of average normalized glucose over nighttime under four light conditions. Our linear mixed model showed no main effect of light on glucose, and an interaction between light at 3 lux and time on glucose. Values are mean ± s.e.m.

Low light at night has an effect on nocturnal glucose

Result 2: Effects of nocturnal light on daytime glycemia

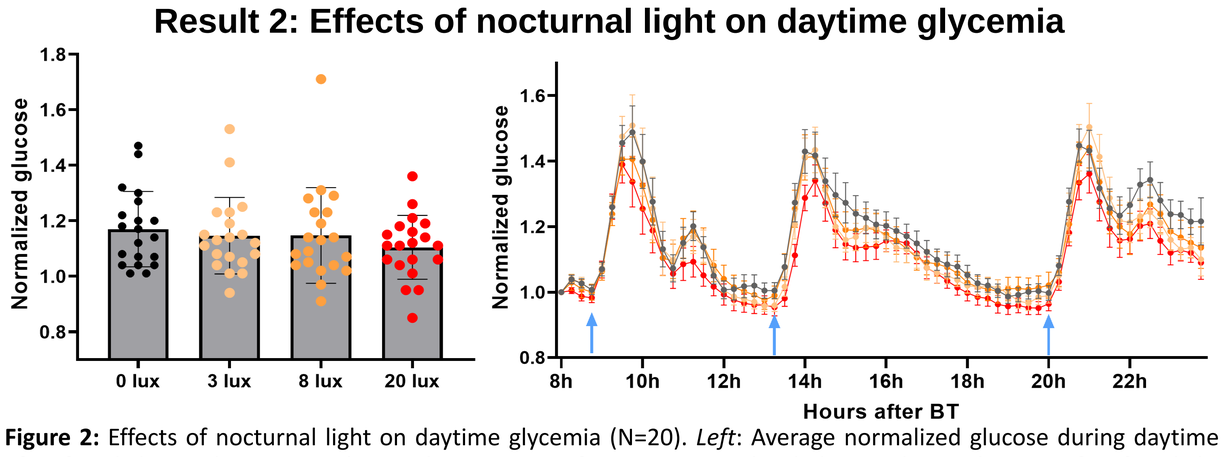


Figure 2: Effects of nocturnal light on daytime glycemia (N=20). *Left*: Average normalized glucose during daytime after four light conditions at night . *Right*: Variation of average normalized glucose during daytime after four light conditions at night. Each meal (blue arrow ≃ first bite) is associated with an initial and a secondary glucose peak. No differences were observed between light conditions (repeated-measures ANOVA). Values are mean ± s.e.m.

Light at night has no effect on daytime glycemia

Result 3: Effects of nocturnal light on glucose in response to breakfast

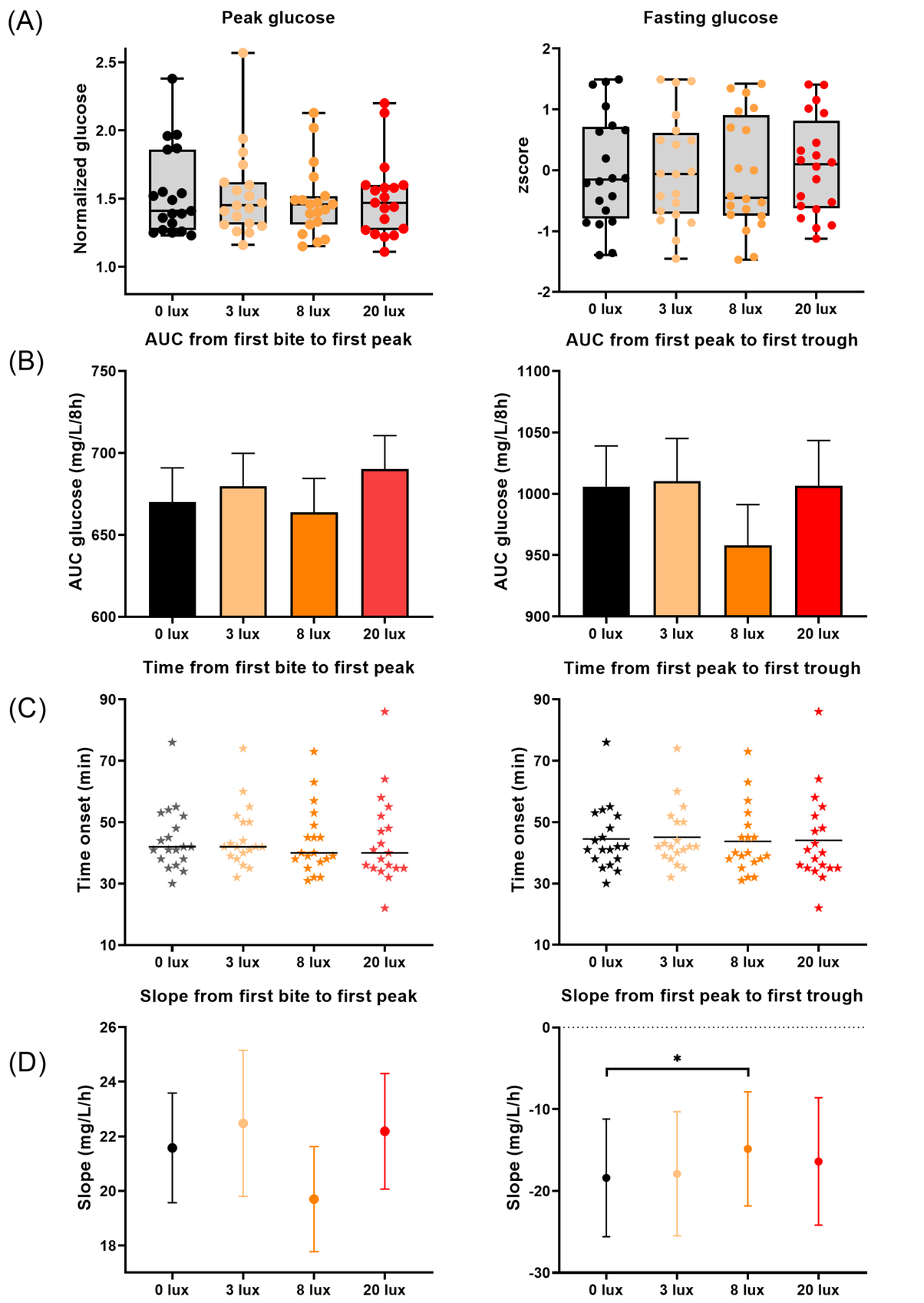


Figure 3: Effects of nocturnal light on glucose in response to breakfast (N=19). Our linear mixed model showed an effect of light condition (8lux) on the glycemic slope from first peak to first trough (D, right)). No differences were found between light conditions for the other parameters. An asterisk indicates that the difference is statistically significant. Values are mean ± s.e.m.

Light at night has an effect on post-breakfast glycemia

Conclusion

These preliminary results suggest that low-intensity artificial light during sleep impacts glucose homeostasis during the night and its response to breakfast, but does not impact daytime glycemia.

References

[1]Kyba CCM, et al.Science.2023;[2]Morin L.P, et al. eNeuro.2015;[3]Poggiogalle E,et al. Metabolism. 2018;[4]Prayag A.S, et al. J Pineal Res. 2019; [5] Prayag A.S, et al. Frontiers Neurosci. 2019.

Funding ANR(Idex ALAN)and Recto lux(UCBL1)to CG, China Scholarship Council to YH, NT.

Contact ni.tang@inserm.fr

https://esleepeurope.eu/