Pre-Sleep Screen Restriction and Adolescent Sleep:

A Study of Subjective Quality and Objective Sleep

Arnav Chandra

Independent Research · 2026

Table of Contents

Abstract

Background: Sleep is an active process crucial for restoration, memory consolidation, brain function and hormonal regulation, and insufficient sleep has been linked to compromised immune function, depression, anxiety and obesity in adolescents (Science of Sleep, n.d.). Screen use before bed is widely considered to disrupt sleep, yet few studies examine how long a screen-free period needs to be to produce a benefit, rather than simply whether screens matter at all. **Purpose:** This report investigates the relationship between the duration of a pre-sleep screen-free environment using both subjective and objective sleep measures in adolescents. **Methods:** The use of a within-subjects field design in which each participant's own data serves as their baseline removes participant variability. Eight adolescents self-tracked their sleep over three to four weeks, contributing 85 nights of data across three conditions: no restriction, a 30-minute screen-free period, and a 60-minute screen-free period. Subjective sleep quality and rested level were self-reported, with objective data being validated via a screenshot. Wake after sleep onset (WASO), awakenings, and sleep-stage composition were recorded via Apple Watch. **Results:** A 30-minute screen-free period was associated with a moderate improvement in subjective sleep quality (+1.04 points, d_z = 0.63), collected using an independent rested-level rating, though the effect was borderline across inferential methods. A 60-minute period proved no additional benefit, and neither WASO nor awakening count changed meaningfully. **Conclusion:** These findings suggest a brief screen-free period may improve perceived sleep, though the small sample (n = 8) means results should be treated as exploratory.

1. Introduction

Many people characterize their sleep quality by the amount of time asleep, and sleep quality is measured by the time spent in different stages, the frequency of waking, and subjective feelings upon waking. Fragmented sleep, characterized by increased wake time after sleep onset (WASO), has been associated with reduced alertness even when sleep duration appears sufficient (Grafe et al., 2023). Insufficient sleep has been linked to compromised cellular immune responses, depression, anxiety and obesity in adolescents (Roberts et al., 2009). As a result, both objective and subjective indicators are necessary for an accurate analysis of sleep quality.

Sleep regulation is governed by the homeostatic physiology of the circadian rhythm, which governs the sleep/wake cycle. Circadian rhythm is an internal clock that regulates alertness and melatonin production, responding to environmental light changes (Reddy et al., 2026). In the evening, low light levels promote melatonin secretion, a hormone that signals the body to prepare for sleep. Exposure to artificial light at this time has been shown to suppress melatonin secretion and delay circadian phase (Gooley et al., 2011). The delay increases WASO and fragmented sleep, thus reducing sleep quality.

Screens such as smartphones, tablets and laptops emit light at levels strong enough to disrupt circadian regulation (Haghani et al., 2024). Roughly 60% of adolescents reported using devices for at least 1 hour before bedtime (Hale et al., 2019). The consumption of social media or gaming increases brain stimulus and heightens alertness, contributing to poor sleep (Yu et al., 2024). The user experiences a combination of passive light exposure and physiological and psychological stimulation, negatively impacting sleep and rest. Pre-sleep screen use has been shown to reduce sleep quality due to disruptions in neurochemical processes (AlShareef, 2022).

The biological phase delay is experienced by those undergoing puberty. It results in a natural shift in circadian timing toward later times, causing adolescents to fall asleep later in the evening (Hagenauer et al., 2009). However, social demands, such as early-morning school commitments, impose restrictions on sleep quality.

2. Methods

2.1 Design

A repeated-measures field design was used. Each participant contributed multiple nights to each of the three conditions categorized by the length of the enforced screen-free period before bed: Control (no restriction), a 30-minute restriction, and a 60-minute restriction of screens. Because each participant experienced more than one condition, each person's control acts as their baseline.

2.2 Participants

Eight adolescents signed up through a Google Form (see Appendix A), each self-tracking their sleep over roughly three to four weeks in early 2026. The number of nights recorded per participant ranged from 4 to 16. Two participants did not contribute any data to the 60-minute screen-free condition, so analyses involving that condition rely on six participants.

2.3 Measures

Subjective results. Each morning, participants recorded their overall sleep quality on a scale of 1-10 and a rested level on a scale of 1-5 via Google Forms (see Appendix B). The two ratings were collected independently to deduce any subjective effect.

Objective results. An Apple Watch (Series 4 or newer) was used to track wake after sleep onset (WASO), the count of discrete awakenings, total sleep time, and the proportion of the night spent in REM, core (light), and deep sleep. The watch estimates these variables using an accelerometer and heart rate rather than EEG, a limitation considered in the Discussion.

Screen condition. The amount of time deliberately spent without screens before sleep (0, 30, or 60 minutes)

2.4 Statistical analysis

Subjective ratings are ordinal, and WASO is strongly right-skewed and bounded at zero, making parametric tests assuming normality faulty. Pooling all 85 nights of data as if they were would create pseudoreplication and inflate significance.

(1) Change relative to baseline: each participant's Control nights reflected their personal zero, and each restricted-condition night was expressed as deviations from it, isolating the within-person effect and removing variables that may skew data. **(2) Within-participant permutation tests:** condition labels were shuffled within each participant (20,000 permutations) to give an exact distribution-free p-value that respects the clustering. **(3) Fixed-effects regression:** all nights were modelled with participant fixed effects, with p-values obtained using a wild cluster bootstrap appropriate for a small number of clusters. **(4) Bootstrap effect sizes:** standardized within-person effects using Cohen's d_z reported with 95% confidence.

Subjective quality was used against the independent rested-level and awakening-count measures. Total sleep time was tested as a potential confound.

2.5 Ethical Considerations

Considering the experiment involves human participation, an informed consent form has been collected from all participants with parental consent (Appendix C), as the volunteers are minors. Participation is voluntary, and participants may withdraw at any time without consequences. All collected data is anonymous, and personal identifiers will be removed, except for gender. Email addresses will be collected solely for participant tracking, to compare participants among themselves, and will be removed before data analysis to remain anonymous.

3. Results

3.1 Data Screening

The dataset contains 85 valid nights from 8 participants (control: 43 nights; 30-minute: 24 nights; 60-minute: 18 nights). Two observations were identified and retained as biologically plausible: one participant woke up far more than any other in every condition, indicating a WASO outlier, and another participant's single 60-minute night received the lowest quality rating in the dataset.

Table 1. Sleep outcomes by condition (all nights pooled, for description only). Values are mean ± SD unless noted. (full data in Appendix D)

Measure	Control	30-min	60-min
Nights/participants	43 / 8	24 / 8	18 / 6
Sleep quality (1–10)	6.49 ± 1.67	7.92 ± 1.18	7.28 ± 1.56
median [range]	7 [3–9]	8 [6–10]	8 [2–9]
WASO (min)	16.4 ± 21.4	19.3 ± 30.4	33.6 ± 35.7
median [range]	10 [0–96]	5.5 [1–125]	18 [0–121]
Rested level (1–5)	3.53 ± 0.83	4.12 ± 0.74	3.94 ± 0.87
Awakenings (count)	1.98 ± 1.14	1.42 ± 1.25	1.78 ± 1.26
Total sleep (min)	429 ± 82	445 ± 101	418 ± 68
REM / Core / Deep (%)	22 / 62 / 14	24 / 59 / 15	26 / 57 / 16

Note. REM/Core/Deep percentages are pooled across all nights within each condition; averaging each participant's own percentage first produces values within ±1.26 percentage point. Percentage points were calculated from RAW data.

The pooling averages in Table 1 indicate the 30-minute condition coincides with the best quality; however, these figures combine the experimental effect with the stable between-person differences and with the unequal number of nights each participant logged per condition. While most participants spent little time awake after falling asleep, a few remained awake for longer periods of time. Consequently, WASO was right-skewed across all conditions, indicating the need for the resampling-based methods described above.

3.2 Screen-free Duration and Subjective Sleep Quality

Relative to each participant's baseline, the 30-minute screen-free period raised subjective quality by 1.04 points. Five of eight participants improved while two worsened and one remained unchanged. A medium-sized personal effect of d_z = 0.63. The findings reveal a methodological lesson (Table 2); when analyzing only eight participants' averages, the results lack statistical power (p = 0.20), while utilizing the complete data reveals a significant effect.

Table 2. The 30-minute-vs-Control quality effect across four inference methods. d_z = Cohen's d_z

Method	Estimate	p-value
Wilcoxon signed-rank (participant means)	+1.04 pts	0.20
Sign-flip permutation (deltas)	+1.04 pts	0.11
Within-participant label permutation	+1.04 pts	0.005
Fixed-effects + wild-cluster bootstrap	+1.39 pts	0.074
Standardized effect (bootstrap CI)	d_z = 0.63	95% CI [−0.01, 1.73]

Contrarily, the 60-minute condition did not prove any quality advantage over the control (within-person change of -0.55 points, permutation p = 0.91 and d_z = -0.19) and actually proved to be slightly worse than the 30-minute condition (−1.11 points; permutation p = 0.075). Therefore, the response is non-monotonic. The benefit appears at 30 minutes, does not increase and may slightly reverse at 60 minutes. Figure 1a shows each participant's results over time. Since each person's experience varied vastly, the overall group results are barely considered statistically significant. Figure 2a shows the exact same results but focuses on how much each individual changed relative to where they started.

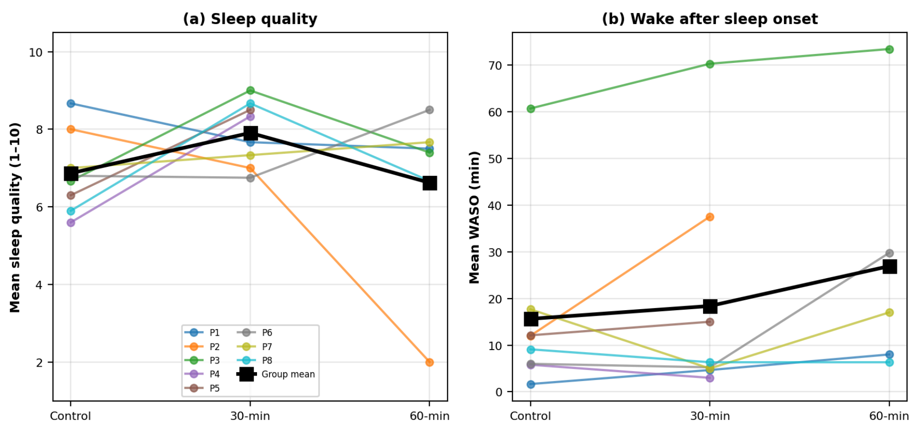


Figure 1. Per-participant results across conditions for (a) sleep quality and (b) wake after sleep onset (WASO). Each coloured line is one participant; the heavy black line is the group mean. Quality rises on average from Control to 30-min; WASO shows no systematic pattern.

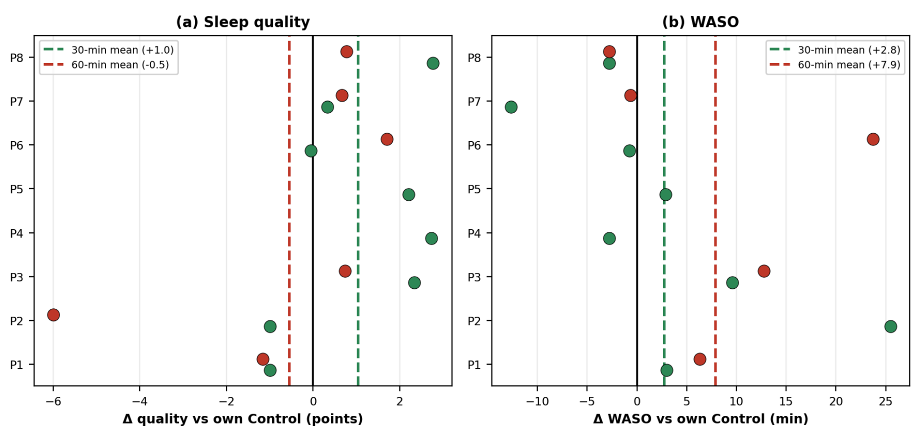


Figure 2. Change from each participant's own Control baseline for (a) sleep quality and (b) WASO. Green points are the 30-minute condition, red the 60-minute; dashed lines are condition means. The 30-minute quality points cluster on the 'better' side, while WASO points scatter on both sides of zero.

3.3 Convergent Evidence between rested level and awakenings

The quality finding is reinforced by the study's other measures, producing a consistent pattern across four outcomes: sleep quality, rested level, awakenings, and WASO (Figure 3, which additionally splits the quality and WASO comparisons into 30- and 60-minute contrasts). The independent rested level rating followed a trend in the same direction and to a similar degree when under 30-minute restriction (+0.40 points; d_z = 0.67). Two independent subjective measurements rising is significant convergent evidence that the effect is real, through the borderline p-values (Table 2) and the confidence intervals that approach zero mean this remains suggestive. By contrast, the number of awakenings did not change with condition (d_z = -0.19), mirroring the WASO results below. The conclusive trend in the dataset is a divergence where two subjective metrics improved while the two structural fragmentation metrics remained unchanged, though given the sample size this pattern is not conclusive.

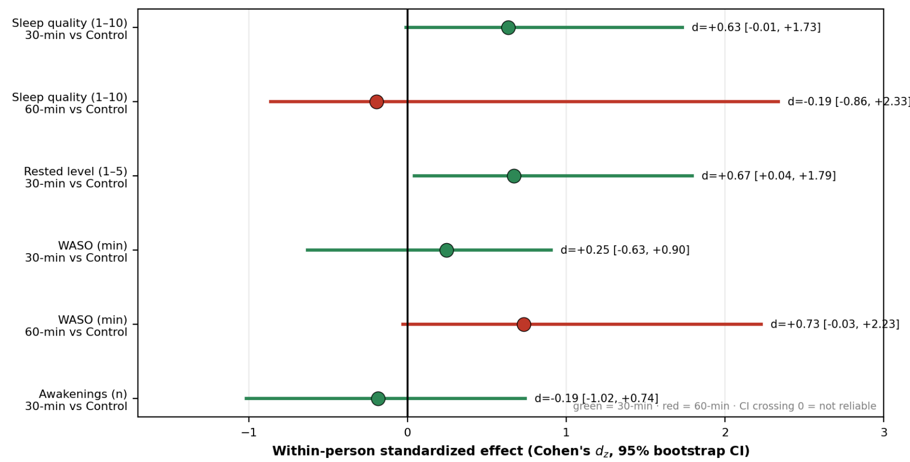


Figure 3. Standardized within-person effects (Cohen's d_z) of screen restriction versus Control across all outcomes. Positive values mean a higher score under restriction (better for quality/rested, worse for WASO/awakenings).

3.4 Screen-free duration and WASO

There was no reliable association between screen-free duration and wake after sleep onset. The within-person change at 30 minutes was negligible (+2.8 min; four participants up, four down). Pre-sleep screen restriction showed no measurable effect on objective mid-sleep wakefulness in this sample (Figure 1b).

Two alternative explanations for the quality effect were directly tested, and neither was supported. Total time asleep did not differ across conditions (429, 445, and 418 minutes), indicating that the 30-minute benefit is not a by-product of sleeping longer. Longer sleep did trend to be higher quality ($r = 0.38$), but sleep duration was not confounded with condition.

The conclusions of the study remain influential observations; excluding any outliers, the 30-minute subjective sleep quality effect remained significant (+0.85 points, permutation $p = 0.023$) and the 60-minute WASO trend remained non-significant, confirming the apparent WASO increase is outlier-dependent. Excluding the single low-rated 60-minute night changed the control versus 60-minute comparison from -0.55 to +0.54, showing that the idea of 60 minutes being worse was a result of one night rather than a true trend. An analysis of sleep architecture, limited to the five participants with complete sleep stage data across all three conditions, found a significant reduction in core (light) sleep with longer restriction (60.2% to 57.7% to 56.4%; Friedman $p = 0.015$). REM (25% to 25.8% to 26.3%) and deep sleep (14.7 to 16.5% to 17.3%) both trended upward but did not reach significance with Friedman $p = 0.247$ for each; these trends are reported as hypothesis-generating only.

4. Discussion

This study finds that a 30-minute pre-sleep screen-free period was associated with a subtly consistent improvement in how adolescents perceived their sleep, with an improvement of roughly one point on a 10-point scale corroborated by an independent rested-level measure, while no measure of objective sleep continuity (WASO) changed with condition. A full hour of restriction did not prove to be more effective compared to only 30 minutes of restriction. Screen restriction was linked to feeling more rested without a significant change in objective wakings.

4.1 Consistency with prior survey evidence

The idea that a screen-free wind-down is associated with better-rated sleep aligns with the direction of large observational studies. The use of computers and cellphones has been associated with more severe insomnia symptoms and a later chronotype (Fossum et al., 2014), and lower actigraphic sleep efficiency in adolescents (Fobian et al., 2016). Media exposure only explains a single-digit to low double-digit percentage of variance in sleep outcomes (Fossum et al., 2014), consistent with the moderate effect observed through the study. The convergence of the two independent subjective ratings in this study strengthens the case that the trend is real despite the small sample keeping it short of definitive.

4.2 The WASO result fits experimental and mechanistic work

The absence of an effect on WASO is consistent with most comparable experiments, which also utilized polysomnography, and found that two hours of evening screen use did not significantly alter objective sleep quality or quantity (Jones et al., 2018). More broadly, the objective signals that emerge in the screen-sleep literature prioritize sleep onset and sleep efficiency (Fobian et al., 2016), and the physiology of melatonin timing, rather than mid-sleep fragmentation. The significant finding is that pre-bed light exposure delays melatonin onset and shortens its duration by roughly 90 minutes (Gooley et al., 2011) because melatonin enables sleep at the start of the night and any disruption would result in prolonged time to fall asleep rather than increase awakenings after sleep onset.

4.3 The effect of 60 minutes without screen

The non-monotonic dose-response benefits at 30 minutes, none beyond it, is odd because a regular light-exposure model predicts that more screen-free time should be uniformly better. Two ideas support this theory. First, the duration that matters could be total screen exposure rather than the wind-down, as melatonin suppression has been observed after several hours of device use but not after shorter exposures (Jones et al., 2018), resulting in the marginal physiological gain from extending a screen-free gap from 30 to 60 minutes may be insignificant. Secondly, a longer buffer is harder to adhere to and may disrupt the pre-sleep routine already established by the participant, adding noise rather than benefit.

4.4 Limitations

Sample and power: with only eight participants and 6 for any 60-minute contrast, power is limited and few-cluster inference is fragile, which is why the quality effect's p-value varies across methods, meaning results should be interpreted as consistent and likely real rather than established. **Measurement:** subjective ratings are open to placebo and expectancy effects, since participants were aware of the hypothesis and may have rated restricted nights more favourably. Screen restriction was self-reported and unverified, and WASO, awakenings and sleep stages came from a consumer wearable that estimates data from movement and heart rate rather than EEG. **Unmeasured data point:** sleep-onset latency, which proved to be more sensitive to pre-sleep screen use than WASO (Gooley et al., 2011; Jones et al., 2018), was not recorded. **Causality:** the design is observational and within a single small group, which identifies associations, not causes.

5. Conclusion

In the study conducted on eight adolescents, a brief 30-minute pre-sleep screen-free period was associated with a moderate improvement in subjective sleep quality, with no added benefit from a longer period and no benefit on objective sleep fragmentation (WASO). The pattern of improved sleep quality without any change in awakenings mirrors a larger study in which screen effects surface most clearly in sleep onset and melatonin timing rather than wakings during sleep. A short 30-minute screen-free window may be part of the common sleep-hygiene advice that does work. In screen-sleep research, the verdict remains dependent on whether the user measures sleep on subjective or objective analysis.

Declaration of competing interests

The author declares none.

Sources

AlShareef, S. M. (2022). The impact of bedtime technology use on sleep quality and excessive daytime sleepiness in adults. *Sleep Science*, *15*(Spec 2), 318–327. https://doi.org/10.5935/1984-0063.20200128

Fobian, A. D., Avis, K., & Schwebel, D. C. (2016). Impact of Media Use on Adolescent Sleep Efficiency. *Journal of Developmental & Behavioral Pediatrics*, *37*(1), 9–14. https://doi.org/10.1097/DBP.0000000000000239

Fossum, I. N., Nordnes, L. T., Storemark, S. S., Bjorvatn, B., & Pallesen, S. (2014). The Association Between Use of Electronic Media in Bed Before Going to Sleep and Insomnia Symptoms, Daytime Sleepiness, Morningness, and Chronotype. *Behavioral Sleep Medicine*, *12*(5), 343–357. https://doi.org/10.1080/15402002.2013.819468

Gooley, J. J., Chamberlain, K., Smith, K. A., Khalsa, S. B. S., Rajaratnam, S. M. W., Van Reen, E., Zeitzer, J. M., Czeisler, C. A., & Lockley, S. W. (2011). Exposure to Room Light before Bedtime Suppresses Melatonin Onset and Shortens Melatonin Duration in Humans. *The Journal of Clinical Endocrinology and Metabolism*, *96*(3), E463–E472. https://doi.org/10.1210/jc.2010-2098

Grafe, L., Miller, K. E., Ross, R. J., & Bhatnagar, S. (2023). The importance of REM sleep fragmentation in the effects of stress on sleep: Perspectives from preclinical studies. *Neurobiology of Stress*, *28*, 100588. https://doi.org/10.1016/j.ynstr.2023.100588

Hagenauer, M. H., Perryman, J. I., Lee, T. M., & Carskadon, M. A. (2009). Adolescent Changes in the Homeostatic and Circadian Regulation of Sleep. *Developmental Neuroscience*, *31*(4), 276–284. https://doi.org/10.1159/000216538

Haghani, M., Abbasi, S., Abdoli, L., Shams, S. F., Baha'addini Baigy Zarandi, B. F., Shokrpour, N., Jahromizadeh, A., Mortazavi, S. A., & Mortazavi, S. M. J. (2024). Blue Light and Digital Screens Revisited: A New Look at Blue Light from the Vision Quality, Circadian Rhythm and Cognitive Functions Perspective. *Journal of Biomedical Physics & Engineering*, *14*(3), 213–228. https://doi.org/10.31661/jbpe.v0i0.2106-1355

Hale, L., Kirschen, G. W., LeBourgeois, M. K., Gradisar, M., Garrison, M. M., Montgomery-Downs, H., Kirschen, H., McHale, S. M., Chang, A.-M., & Buxton, O. M. (2018). Youth screen media habits and sleep: Sleep-friendly screen-behavior recommendations for clinicians, educators, and parents. *Child and Adolescent Psychiatric Clinics of North America*, *27*(2), 229–245. https://doi.org/10.1016/j.chc.2017.11.014

Jones, M. J., Peeling, P., Dawson, B., Halson, S., Miller, J., Dunican, I., Clarke, M., Goodman, C., & Eastwood, P. (2018). Evening electronic device use: The effects on alertness, sleep and next-day physical performance in athletes. *Journal of Sports Sciences*, *36*(2), 162–170. https://doi.org/10.1080/02640414.2017.1287936

Reddy, S., Reddy, V., & Sharma, S. (2026). Physiology, Circadian Rhythm. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK519507/

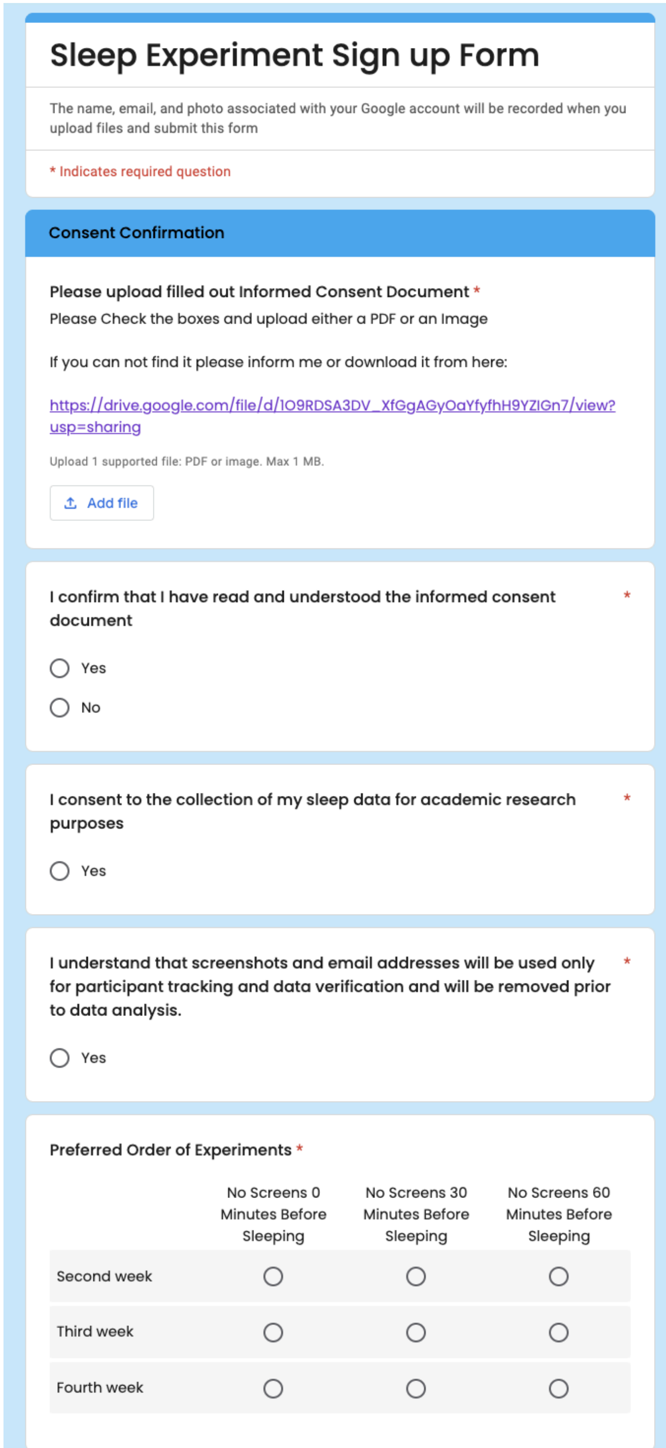
Roberts, R. E., Roberts, C. R., & Duong, H. T. (2009). Sleepless in adolescence: Prospective data on sleep deprivation, health and functioning. *Journal of Adolescence*, *32*(5), 1045–1057. https://doi.org/10.1016/j.adolescence.2009.03.007

Science of Sleep: What is Sleep? | Sleep Medicine. (n.d.). Retrieved March 25, 2026, from https://sleep.hms.harvard.edu/education-training/public-education/sleep-and-health-education-program/sleep-health-education-47

Yu, D. J., Wing, Y. K., Li, T. M. H., & Chan, N. Y. (2024). The Impact of Social Media Use on Sleep and Mental Health in Youth: A Scoping Review. *Current Psychiatry Reports*, *26*(3), 104–119. https://doi.org/10.1007/s11920-024-01481-9

Appendix A: Sign Up Form

The use of a Google Form to collect data from the participants.



Sleep Experiment Sign up Form

The name, email, and photo associated with your Google account will be recorded when you upload files and submit this form

* Indicates required question

Consent Confirmation

Please upload filled out Informed Consent Document *

Please Check the boxes and upload either a PDF or an Image

If you can not find it please inform me or download it from here:

https://drive.google.com/file/d/1O9RDSA3DV_XfGgAGyOaYfyfhH9YZIGn7/view?usp=sharing

Upload 1 supported file: PDF or image. Max 1 MB.

Add file

I confirm that I have read and understood the informed consent document *

- Yes
- No

I consent to the collection of my sleep data for academic research purposes *

- Yes

I understand that screenshots and email addresses will be used only for participant tracking and data verification and will be removed prior to data analysis. *

- Yes

Preferred Order of Experiments *

	No Screens 0 Minutes Before Sleeping	No Screens 30 Minutes Before Sleeping	No Screens 60 Minutes Before Sleeping
Second week	○	○	○
Third week	○	○	○
Fourth week	○	○	○

Appendix B: Daily Sleep Data Collection Form

Daily collection form of data for subjective and objective data.

Quality of your Sleep - Daily Form

The name, email, and photo associated with your Google account will be recorded when you upload files and submit this form

* Indicates required question

Qualitative Sleep Analysis

Please answer how you feel walking up this morning

What was your quality of sleep *

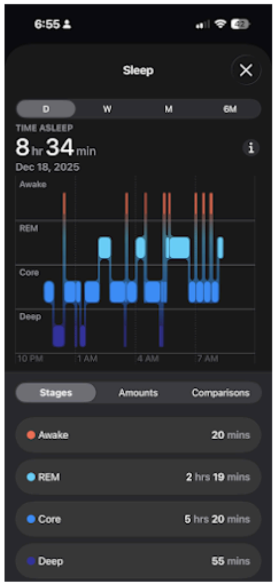
	1	2	3	4	5	6	7	8	9	10	
Very Poor	○	○	○	○	○	○	○	○	○	○	Excellent

How rested do you feel *

	1	2	3	4	5	
Not at all	○	○	○	○	○	Fully Rested

Upload a screenshot of the Apple Health Sleep Summary for last night. *

Make sure the date and sleep metrics are visible.
Health app → Sleep → Show More Sleep Data



Upload 1 supported file. Max 10 MB.

Add file

Copy and Paste Data *

With the screenshot select **ALL** the text and copy and paste into the textbox bellow

Don't worry if the text looks weird. That's normal. Please make sure **ALL** the text is selected.

Your answer

Appendix C: Informed Consent Form

Section 2.5 references informed consent collected from all participants with parental consent. Below is the template of the form that was distributed.

Sleep Study – Participant Instructions and Consent Form

Requirements:

- Complete the form first thing in the morning after waking.
- Accurately enter the requested information each day.

Information Collected:

- Email (used only for tracking)
- Sleep data from Apple Health:
    - Bedtime and wake time
    - Duration of sleep stages
    - Total sleep duration
- Subjective measures:
    - Sleep quality
    - How rested you feel
    - Number of times you remember waking up
- Screen use: Duration of screen exposure within 60 minutes before bedtime

Time Commitment:

- The form should take approximately 2 minutes per day.

Experimental Task:

- Over the 4-week study period, you will be asked to adjust your screen time before bed according to the experiment instructions.

Informed Consent

Please read and acknowledge the following statements before participating:

1. I understand that the purpose of this study is to explore the relationship between screen use before bedtime and sleep quality.
2. I understand that participation is voluntary, and I may withdraw at any time without penalty.
3. I consent to provide sleep data (both objective from Apple Health and subjective self-report) for research purposes.
4. I understand that my data will be anonymized and stored securely. Screenshots and email addresses are used only for verification and tracking.
5. I understand that the results may be used in an academic report (Extended Essay) or scientific report.
6. I confirm that I have read and understood these statements and agree to participate.

For Participants Under 18

- Parent or guardian consent is required for participation.
- Please confirm below that your parent/guardian has reviewed and approved your participation in the study.

Consent Confirmation

☐ I am under 18 years old and have parental/guardian consent to participate.

☐ I have read and understood the instructions and agree to participate in this study.

Parent / Guardian Signature: ________________________________

Participant Signature: ______________________________________

Appendix D: Raw Participant Data

Table A1 lists the night-by-night dataset underlying Table 1 in the main report of all 85 nights. Participants are strictly identified by code (P1-P8) to preserve anonymity. A dash (-) indicates that data were missing or unusable.

Participant	Condition	Night #	Quality (1–10)	Rested (1–5)	Awakenings	Total Sleep (min)	WASO (min)	REM (min)	Core (min)	Deep (min)
P1	Control	1	9	4	3	454	4	119	290	45
P1	Control	2	8	4	0	340	1	92	151	97
P1	Control	3	9	5	0	450	0	116	273	61
P1	30-min	4	8	4	0	457	8	117	254	86
P1	30-min	5	7	5	0	311	4	63	182	66
P1	30-min	6	8	4	0	427	2	113	225	89
P1	60-min	7	7	3	1	395	16	95	224	76
P1	60-min	8	8	5	0	338	0	75	170	93
P2	Control	1	8	4	0	478	12	95	332	39
P2	30-min	2	7	4	0	473	9	106	318	49
P2	30-min	3	7	3	0	438	66	87	329	22
P2	60-min	4	2	3	1	516	—	—	—	—
P3	Control	1	7	4	2	457	85	134	286	37
P3	Control	2	8	5	3	503	65	109	361	33
P3	Control	3	9	4	2	532	47	127	374	31
P3	Control	4	6	4	3	367	42	128	212	27
P3	Control	5	3	4	3	545	96	116	371	58
P3	Control	6	7	4	3	441	29	108	258	75
P3	30-min	7	8	5	3	474	125	129	313	32
P3	30-min	8	9	5	3	561	61	157	335	69
P3	30-min	9	10	5	2	506	26	134	313	59
P3	30-min	10	9	4	3	508	69	122	326	60
P3	60-min	11	7	3	2	357	24	135	183	39
P3	60-min	12	8	5	3	561	81	154	355	52
P3	60-min	13	8	4	2	440	121	124	294	22

Participant	Condition	Night #	Quality (1–10)	Rested (1–5)	Awakenings	Total Sleep (min)	WASO (min)	REM (min)	Core (min)	Deep (min)
P3	60-min	14	6	5	3	418	87	101	274	43
P3	60-min	15	8	5	3	498	54	106	323	69
P4	Control	1	7	4	1	409	1	78	283	48
P4	Control	2	4	3	1	382	1	64	266	52
P4	Control	3	5	3	3	449	11	92	312	45
P4	Control	4	5	4	3	—	12	78	363	33
P4	Control	5	7	4	1	396	4	103	236	57
P4	30-min	6	8	4	0	403	5	100	232	71
P4	30-min	7	8	5	0	531	1	145	313	73
P4	30-min	8	9	5	1	590	3	142	363	85
P5	Control	1	4	2	3	344	24	70	201	73
P5	Control	2	7	3	2	306	3	58	176	72
P5	Control	3	8	4	2	530	5	110	370	50
P5	Control	4	7	4	1	633	5	123	461	49
P5	Control	5	8	4	3	487	21	67	284	50
P5	Control	6	8	4	2	611	14	77	491	43
P5	Control	7	4	2	3	528	10	53	309	91
P5	Control	8	6	3	3	559	18	94	330	69
P5	Control	9	5	3	3	375	6	59	255	60
P5	Control	10	6	4	3	366	15	46	232	88
P5	30-min	11	9	4	3	649	10	83	331	75
P5	30-min	12	8	4	3	545	20	70	270	58
P6	Control	1	7	3	3	418	19	85	277	56
P6	Control	2	6	3	0	421	0	85	298	38
P6	Control	3	8	4	1	442	2	116	247	79
P6	Control	4	7	4	0	451	0	116	267	68
P6	Control	5	6	3	2	447	9	132	285	30
P6	30-min	6	7	4	2	417	4	113	240	64
P6	30-min	7	7	3	2	400	3	106	259	35
P6	30-min	8	7	4	2	415	13	104	265	46
P6	30-min	9	6	3	2	397	1	115	240	42

Participant	Condition	Night #	Quality (1–10)	Rested (1–5)	Awakenings	Total Sleep (min)	WASO (min)	REM (min)	Core (min)	Deep (min)
P6	60-min	10	8	4	3	423	23	90	256	77
P6	60-min	11	9	5	3	445	68	136	211	98
P6	60-min	12	9	5	3	418	18	96	194	53
P6	60-min	13	8	4	3	350	10	78	231	41
P7	Control	1	6	3	0	341	27	77	217	47
P7	Control	2	7	4	0	348	20	91	181	76
P7	Control	3	8	4	1	471	6	119	271	81
P7	30-min	4	8	4	1	472	4	137	253	82
P7	30-min	5	7	3	2	421	6	106	253	62
P7	30-min	6	7	4	0	191	5	49	79	63
P7	60-min	7	7	4	1	387	33	106	215	66
P7	60-min	8	8	4	0	497	16	150	267	80
P7	60-min	9	8	3	0	405	2	134	196	75
P8	Control	1	7	4	3	374	14	91	213	70
P8	Control	2	9	4	2	456	1	134	281	41
P8	Control	3	6	3	2	395	9	44	194	62
P8	Control	4	9	5	2	489	26	110	341	38
P8	Control	5	6	3	3	346	6	95	173	78
P8	Control	6	4	2	3	279	0	70	157	52
P8	Control	7	4	2	3	374	14	91	213	70
P8	Control	8	4	2	1	346	8	71	204	71
P8	Control	9	4	2	3	351	10	95	217	39
P8	Control	10	6	4	3	324	3	75	173	76
P8	30-min	11	10	5	3	470	11	143	247	80
P8	30-min	12	10	5	0	298	3	66	173	59
P8	30-min	13	6	3	2	317	5	71	189	57
P8	60-min	14	7	3	0	342	4	83	179	80
P8	60-min	15	6	3	3	305	13	67	161	77
P8	60-min	16	7	3	1	430	2	125	267	38