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The Effect of Increased Blue Light Exposure on Sleep Hygiene

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Introduction

Sleep is the most fundamental component for our health and well-being (Brand & Kirov, 2011). Inadequate sleep results in poor physical (Tobaldini et al., 2017) and mental health (Bates et al., 2020), as well as cognitive fatigue (Lim & Dinges, 2012). In a study investigating the relationships between sleep quality, the autonomic nervous system (ANS) function, and cardiovascular disease, Tobaldini et al. (2017) found that sleep deprivation positively correlated with congestive heart failure, hypertension, coronary artery diseases, atrial fibrillation, and metabolic diseases. Regarding mental health, Bates et al. (2020) determined that insufficient sleep can result in increased anxiety as well as mood swings. There is abundant research that demonstrates the harmful implications of poor sleep. Given the increased risk of cognitive and physical dysfunction, it is vital to engage in healthy sleep habits. Research also shows that blue light, emitted by several types of technologies including smartphones, tablets, and computers, impacts general quality of sleep (Heiting, 2020). Central to the understanding of how and why blue light disrupts sleep, lies the importance of understanding the circadian rhythm. The circadian rhythm works as the "internal clock" and facilitates the production and regulation of the "sleep hormone" known as melatonin; it operates largely according to light exposure (Borjigin at al., 2012). Therefore, light exposure is a well-known disruptor of healthy sleep. We infer that screen exposure from laptops and smartphones (as well as other blue light emitting devices) mitigate duration and quality of sleep, as evidenced by negative physical, mental, and cognitive impacts. This is by no means a new area of research. There exists a solid foundation for the understanding on the impact of blue light on sleep as well as the repercussions of poor sleep quality. However, the recent pandemic forced all workplaces and school settings to adapt to either an entirely virtual or semi-virtual format (Wong, 2020).We aim to investigate how increased blue light exposure due to the 2020 COVID-19 pandemic impacts self-reported sleep quality, sleep duration, and cognitive function amongst college students.

Empirical Question

What impact does the increase in blue-light exposure during the COVID-19 pandemic have on self-reported sleep quality, sleep duration, subjective energy and cognitive attention of college students?

Participants

Projected sample sizes are based on an ad hoc sample size and power analysis to ascertain the minimum sample size required for a total of 200 participants (100 females, 100 males), with a minimum power coefficient of 0.70. Convenience sampling will occur on the Pacific University campus from the undergraduate population, using email solicitation, list serves, fliers, and word-of-mouth. We anticipate the average age of the sample will be 20 years old.

Proposed Method

Pre-Experimental Demographics Questionnaire will be used to collect descriptive information about the participant, self-reported sleep hygiene and covariates.

Post-Experimental Questionnaire will be used to assess the participants sleep quality after the manipulation of the independent variables.

Research Randomizer® will be used to randomly assign participants

Sleep Diary containing questions about nightly routines and sleep hygiene throughout the experiment will provide descriptive information about the participants sleep quality.

Qualtrics, an online survey software, will be used to distribute an informed consent procedure and all surveys.

A general demographic survey will be distributed to each subject. Our experiment is composed of two groups, a survey-exclusive group and an experimental group. The survey-exclusive group does not take part in the experiment and only takes part in the survey. The experimental group takes part in both the survey and experiment. For the experimental portion of this study, a selected group of college students who are actively enrolled at Pacific University will participate in a consecutive five-day sleep study. Each group will fill out a sleep diary to keep track of sleep quality and technology patterns over the experimental period. After the participants have completed the study, they will be asked to fill out a post-experimental survey. Appropriate statistical analyses will be completed using SPSS®.

Proposed Results

A Pearson's r assessment will be used to determine the significance between two variables from data collected by the general survey. A Multivariate Analysis of Variance will be used for the experimental condition and the four dependent variables. A Bonferroni Adjustment will be used as a post-hoc assessment for within-subject significance relative to levels of the independent variable. An effect size estimate will be conducted for any significant main effects or interactions. A MANCOVA will be used for the select covariates above as well gender and year in college. We expect to reject the null hypothesis. We predict to see a decrease in quality of sleep, sleep duration, subjective energy, and cognitive attention because of increased blue light.

Conclusion

We expect the results of this experiment to shed light on the relationship between sleep and increased blue-light exposure. When we do not have a choice but to be exposed to blue light, we need to be equipped with knowledge that can assist us in making the best decisions. The results of this study will be beneficial for the inevitable technology-driven society that we are rapidly becoming accustomed to. This knowledge should be applied to our own sleep routines. College students are already prone to adopting poor sleep habits, so this information can provide a guideline for healthy sleep habits. The importance of sleep cannot be ignored. Sleep affects everyone. Prior to this pandemic, we lived in a virtually driven society, however, the pandemic has facilitated a reliance on technology use and screen time exposure like we have never seen before.

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References

Bates, L. C., Zieff, G., Stanford, K., Moore, J. B., Kerr, Z. Y., Hanson, E. D., Gibbs, B. B., Kline, C. E., & Stoner, L. (2020). COVID-19 impacted on behaviors across the 24-hour day in children and adolescents: physical activity, sedentary behavior, and sleep. *Children, 7*(128), 1-9. doi:10.3390/children7090138

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety; psychometric properties. *Journal of Consulting and Clinical Psychology, 56,* 893-897. https://doi.org/10.1037/t00742-000

Beck, A. T., Steer, R. A., & Brown, G. (1996). Beck depression inventory-II [Database record]. APA PsycTests. https://doi.org/10.1037/t00742-000

Borjigin, J., Zhang, L. S., & Calinescu, A. A. (2012). Circadian regulation of pineal gland rhythmicity. *Molecular and cellular endocrinology, 349*(1), 13–19. https://doi.org/10.1016/j.mce.2011.07.009

Brand, S., & Kirov, R. (2011). Sleep and its importance in adolescence and in common adolescent somatic and psychiatric conditions. *International Journal of General Medicine, 4*, 425-442. doi: 10.2147/IJGM.511557

Center for Disease Control and Prevention (2016). 1 in 3 adults don't get enough sleep. https://www.cdc.gov/media/releases/2016/p0215-enough-sleep.html

Drijfhout, W. J., van der Linde, A. G., Kooi, S. E., Grol, C. J., & Westerink, B. H. (1996). Norepinephrine release in the rat pineal gland: The input from the biological clock measured by in vivo microdialysis. *Journal of Neurochemistry, 66,* 748-755. doi: 10.1046/j.1471-4159.1996.66020748.x.

Fuller, C., Lehman, E., Hicks, S., & Novick, M. B. (2017). Bedtime use of technology and associated sleep problems in children. *Global Pediatric Health*, *4*,1-8. DOI: 10.1177/2333794X17736972

Heiting, G. (2020). *Blue light facts: How blue light affects your eyes.* https://www.allaboutvision.com/cvs/blue-light.htm

Jniene, A., Errguig, L., El Hangouche, A. J., Rkain, H., Aboudrar, S., El Ftouh, M., & Dakka, T. (2010). Perception of sleep disturbances due to bedtime use of blue light-emitting devices and its impact on habits and sleep quality among young medical students. *BioMed Research International*, 1-8. doi: https://doi.org/10.1155/2019/7012350

Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychol Bull, 136*(3), 375-389. doi:10.1037/a0018883

Pilcher, J. J., Ginter, D. R., & Sadowsky, B. (1997). Sleep quality versus sleep quantity: relationships between sleep and measures of health, well-being and sleepiness in college students. *Journal of Psychosomatic Research, 42*(6), 583-596. doi: 10.1016/s0022-3999(97)00004-4.

Suni, E. (2020, August 14). *Sleep hygiene*. SleepFoundation. https://www.sleepfoundation.org/articles/sleep-hygiene

Tobaldini, E., Constantino, G., Solbiati, M., Cogliati, C., Kara, T., Nobili, L., & Montano, N. (2016). Sleep, sleep deprivation, autonomic nervous system and cardiovascular disease. *Neuroscience and Behavioral Reviews, 74*, 321-329. doi: https://doi.org/10.1016/j.neubiorev.2016.07.004

Urbaniak, G. C., & Plous, S. (2020). Research randomizer. https://www.randomizer.org/

Walker, M. P. (2009). The role of sleep in cognition and emotion. *Annals of the New York Academy of Sciences, 1156*, 168-197. doi:10.1111/j.1749-6632.2009.04416.x.

West, K. E., Jablonski, M. R., Warfield, B., Cecil, K. S., James, M., Ayers, M. A., Maida, J., Bowen, C., Sliney, D. H., Rollag, M. D., Hanifin, J. P., & Brainard, G. C. (2010). Blue light from light-emitting diodes elicits a dose-dependent suppression of melatonin in humans. *Journal of Applied Physiology 110*, 619-626. doi: 10.1151/japplphysiol.01413.2009

Wong, M. (2020). Stanford research provides a snapshot of a new working-from-home economy. Stanford News. https://news.stanford.edu/2020/06/29/snapshot-new-working-home-economy/

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