

## Improving Student Sleep Quality and Quantity to Improve Higher Educational Experience

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### BACKGROUND

- ✧ A wide-range of literature explores the detrimental effect of poor sleep quality on learning (Mah et al., 2018).
- ✧ Poor sleep hygiene negatively impacts cognitive and physical abilities and is common among higher education students (Curcio et al., 2006).

### AIM

- ✧ To investigate the quality and the perspective of sleep in medical students at Imperial College.
- ✧ To propose methods to increase sleep quality and improve mental health.

### METHODS

An anonymous, voluntary and self-administered questionnaire was made available to medical students at Imperial College London (Table 1).

- Demographic information was collected, and questions to determine existing sleep quality, based on those in the Pittsburgh Sleep Quality Index (Buysse et al., 1989):
  - Sleep quality (0 to 4)
  - Duration (in h)
  - Latency (min)
  - Presence of bed partner
- Questions regarding understanding of, and desire for sleep hygiene interventions were created on a 5-point Likert scale, ranging from 4 (strongly agree) to 0 (strongly disagree).
- Students were also asked to rank, the aspects in their lifestyle that warranted the most attention for improvement out of six categories: Nutrition, Sleep, Emotional Self Care, Finance, Exercise and Global Citizenship.

### RESULTS

#### Quality of sleep

- Responses were received from 113 students (60 female) across all years.
- Students felt that an increase in the total sleep duration will increase sleep quality and decrease tiredness throughout the day (Figures 1 & 2).
- The main factors influencing sleep quality are shown in Table 2, together these accounted for 29.0% (r<sup>2</sup>) of the variation in sleep quality.
- Gender did not influence the assessed sleep variables (Table 3).
- A low quality of sleep negatively impacted activities in the morning (glm, p=0.0006, overall adjusted r<sup>2</sup>=0.17) and in the afternoon (p=0.02), but not in the evening (p=0.06) (Table 4). The presence of a bed partner, pain, temperature, breathing problems and waking up at night did not significantly influence sleep quality.
- Students reported to be more tired in the morning (1.03±0.97; 0=always tired, 3=never tired) than in the afternoon (1.52±0.83; p=0.0002).
- A lower sleep quality was correlated with difficulties to stay awake when performing social or cognitive activities (glm, estimate = -0.45, p=0.003).
- Interestingly sleep duration was not correlated with difficulties to stay awake (glm, estimate = -0.017, p=0.62; correlation, t=0.99, p=0.33).

Table 2: The main factors influencing self-perceived sleep quality, using a linear model

	Estimate	P-value
Latency to fall asleep	-0.26	P<0.00001
Sleep duration	0.07	P=0.001
Presence of dreams	-0.17	P=0.02
Waking up at night	-0.04	P=0.51
Trouble breathing	0.045	P=0.73
Snoring	-0.10	P=0.39
Temperature	0.08	P=0.28
Pain	-0.01	P =0.90

Table 3: Gender does not influence sleep in general (Wilcoxon tests)

	Estimate	Avg F	Avg M	P-value
Sleep Quality	W=1295	2.67	2.76	P=0.44
Sleep duration	W=1346	6.38	6.37	P=0.72
Trouble staying awake in the day	W = 1497	1.02	0.90	P=0.52

Table 4: Low sleep quality causes tiredness in the morning and afternoon, but not the evening (Generalised linear model)

	Estimate	P-value
Morning	0.56	P<0.00001
Afternoon	0.38	P=0.002
Evening	0.26	P=0.08

#### Perspective on sleep

- Students from across all years strongly agreed that their sleeping habits could be improved (Mean [Sd]: 3.13 ± 0.86).
- There was consensus about the need to sleep better with sleep ranking top out of the six suggested categories for improvement.
- Equipping students with the time and energy management tools needed to maintain consistent sleep of adequate duration would be well received (Mean [Sd]: 2.73 ± 0.97).
- Students understand the beneficial relationship of better sleep with learning, and agree that a concerted intervention effort, such as having sleep promotion activities across campus would be beneficial for their medical education (Mean [Sd]: 2.65±0.90).

Table 1. The anonymous self-administered questionnaire (based on the Pittsburg Sleep Quality Index; Buysse et al., 1989).

Background information & sleep statistics during the last month	Rank the elements in your lifestyle that you believe deserve most attention for improvement
Gender & Year of study	Self care
When have you usually gone to bed	Finances
How long (in minutes) has it taken you to fall asleep each night?	Exercise
What time have you usually gotten up in the morning?	Citizenship
How many hours of actual sleep did you get at night?	Nutrition
Rate of your overall quality of sleep	Sleep
How often did you need to take medicine to go to sleep	Cause of trouble of sleep:
How often have you had trouble staying awake? how much of a problem has it been for you to keep up enough enthusiasm to get things done?	Cannot get to sleep within 30 min
Do you have a bed partner/roommate?	Wake up during sleep
Do you feel tired during the evening/afternoon/morning?	Feel too cold or too hot
	Cannot breathe comfortably
	Dreams
	Cough or snore loudly
	Pain

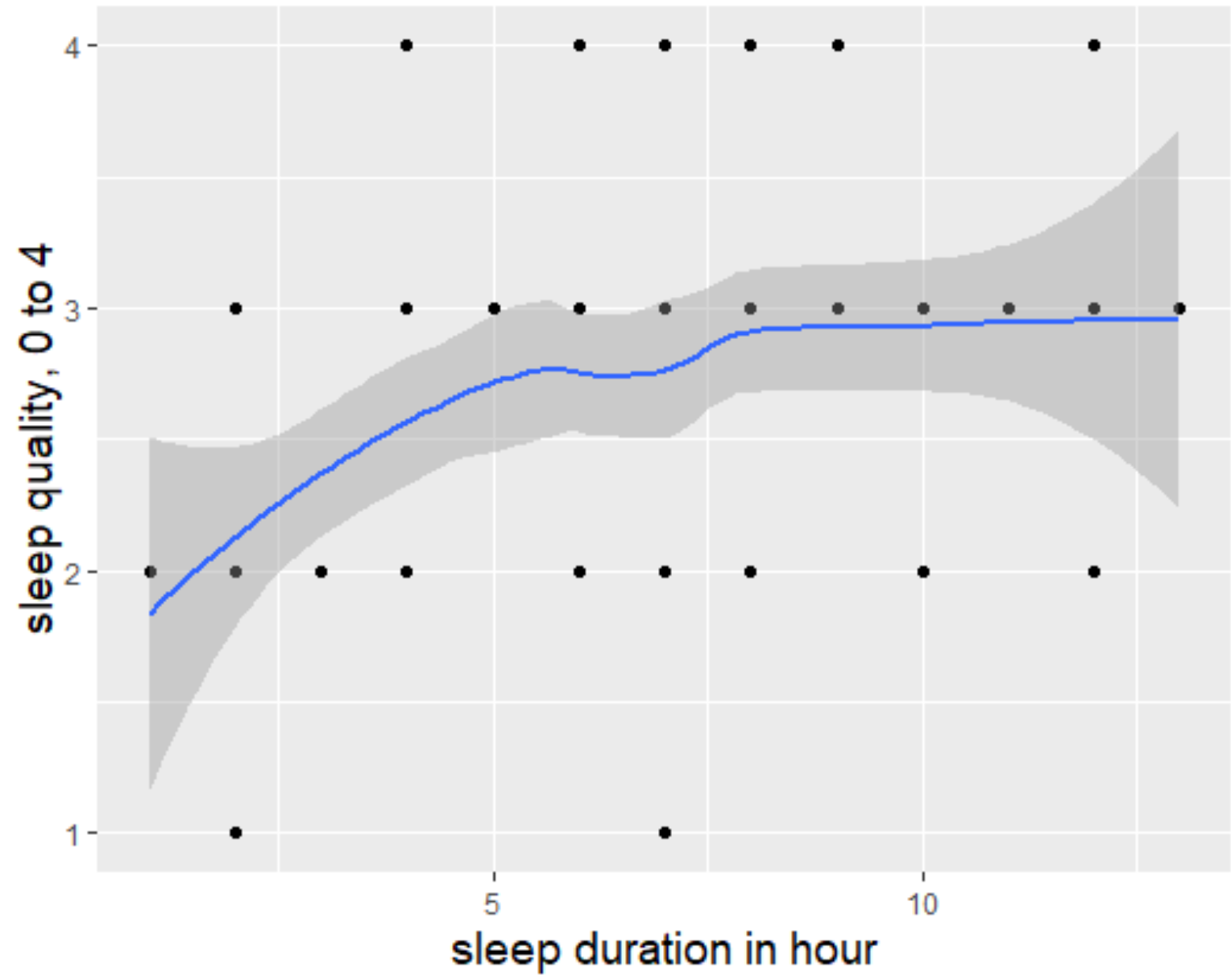


Figure 1. An increase in the total sleep duration will increase sleep quality.

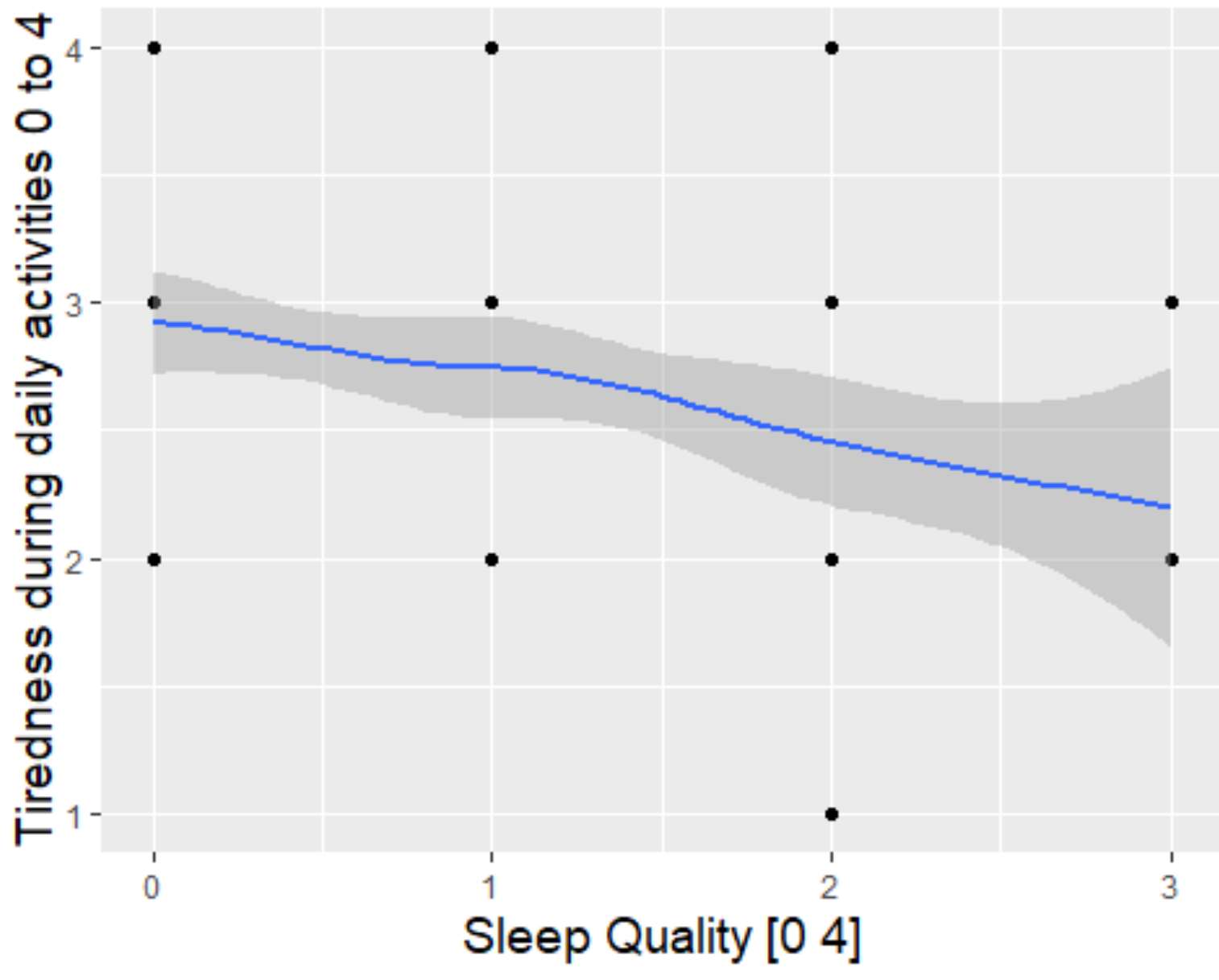


Figure 2. A higher sleep quality decreases tiredness throughout the day.

### CONCLUSION

- Students understand the importance of sleep and would be receptive of initiatives to improve sleep quality.
- Efforts for improving sleep quality should be directed at providing the resources to decrease the latency to sleep onset (Bartel et al., 2018) to increase quality and increase sleep duration via naps (Hayashi, Motoyoshi & Hori, 2005).
- The SleepPod, a next generation transportable sleeping unit that optimises sleeping conditions using machine learning (Figure 3), could be a solution to poor sleep quality by increasing sleep duration in a gamified way (Qiu, 2017).
- The SleepPod differentiates itself from competitor systems by incorporating a non-invasive system to collect and analyse human-derived data. Using Principal Component Analyses, we have been able to create algorithms that model the different stages of sleep. Building the first prototype involved developing expertise in data management, sleep research, machine learning and electrical engineering.

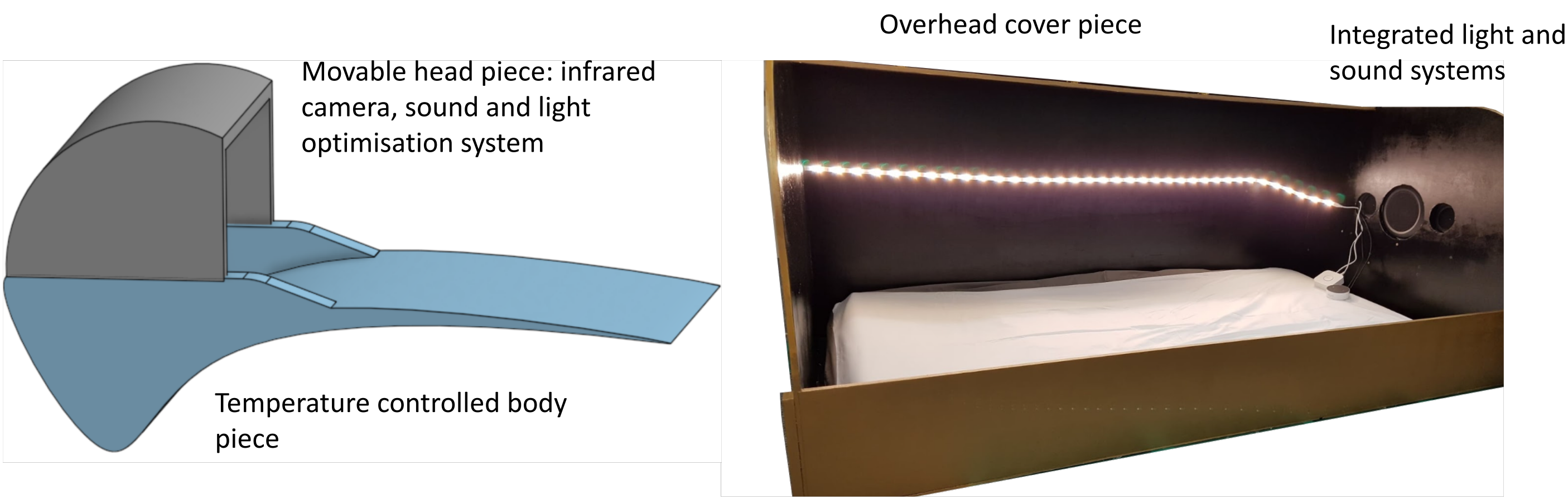


Figure 3. The Imperial Sleep Pod is a next generation portable device that optimises sleeping time, temperature, posture, odour, etc. while tracking data using Machine Learning algorithms. Version 2.0 on the left; version 1.0 on the right (discontinued). Ref. SleepImperial.com

#### References

Buyse, D.J., Reynolds III, C.F., Monk, T.H., Berman, S.R. and Kupfer, D.J., 1989. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, 28(2), 193-213. Curcio G, Ferrara M, De Gennaro L. 2006. Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews*. 10(5):323-337. Bartel, K., Huang, C., Maddock, B., Williamson, P. & Gradsar, M. (2018) Brief school-based interventions to assist adolescents' sleep-onset latency: Comparing mindfulness and constructive worry versus controls. *Journal of Sleep Research*. 27 (3), e12668. Hayashi, M., Motoyoshi, N. & Hori, T. (2005) Recuperative power of a short daytime nap with or without stage 2 sleep. *Sleep*. 28 (7), 829-836. Mah, C. D., Kezirian, E. J., Marcello, B. M. & Dement, W. C. (2018) Poor sleep quality and insufficient sleep of a collegiate student-athlete population. *Sleep Health*. 4 (3), 251-257. Qiu, C. (2017) The impact of a gamified world on medical education. *Education for Health*. 30 (3), 256.