

# *PROJECT PLAN*

Bachelor assignment 2020



Western Norway University of Applied Sciences  
Faculty of Engineering



Harvard Medical School  
Department of psychiatry



VA Boston Healthcare System  
West Roxbury

May 29<sup>th</sup>, 2020

## **PROJECT PLAN**

**Names:** Stine Hereid Myklatun and Konstanse Skogøy Innvær

**Tutor:** Dr. Alvhild Alette Bjorkum and Dr. Radhika Basheer

**Laboratory:** Section of Molecular Neuroscience, Laboratory of Neuroscience, Harvard Medical School, Department of Psychiatry at V.A. Boston Healthcare System. Boston, MA, US and Department of Safety, Chemistry and Biomedical Laboratory Sciences, Faculty of Engineering and Science, Western Norway University of Applied Sciences, Kronstad, Bergen, Norway.

### **1. Title of the project:**

“Sleep deprivation and its consequences on health with – emphasis on metabolic and immunological functions”

### **2. Background, problem:**

Adequate sleep is essential for the psychological, physiological, and cognitive wellbeing in all of animal kingdom. At least 7 hours of sleep are recommended for adults, nevertheless, sleep deprivation is becoming a prevalent public health issue in our society. In brief, the effects of sleep loss are both broad and critically, and numerous systems are affected. However, over a thousand studies of sleep deprivation have been published during the past ten years and resulting knowledge database has been outstandingly consistent.

There is a growing body of observational evidence suggesting a significant link between insufficient sleep duration and increased risk of diabetes, obesity and hypertension. In this short review we want to enhance our knowledge about the detrimental effects of sleep deprivation on metabolism, with focus on its profound deleterious effects on blood pressure and insulin sensitivity and glucose metabolism. Sleep deprivation-induced circadian misalignment can possibly lead to dysregulation of the bacterial population in the gastrointestinal tract (GIT). Moreover, upregulation of endocannabinoid system (ECS) may lead to increased hunger and appetite due to higher plasma levels of 2-arachidonoylglycerol (2-AG) as a result of restricted sleep. By this, adequate sleep should be highly recommended as an important factor in addition to common treatment of obesity and diabetes.

The immune system, the circadian clock and sleep are all linked together. Together they maintain homeostasis, where imbalance may cause detrimental effects on each other. It has been observed that cytokines and other chemical mediators that belongs to the organism's host defense, also function as sleep regulators, either directly or indirectly. Cytokines, such as interleukin (IL)-1 $\beta$  and tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ) affects sleep, as well as taking a part in inflammation response. Studies suggest that sleep disturbance is a trigger for low grade chronic inflammation, which include diseases as mentioned above. We will focus on changes in the metabolic and immune system as a response to sleep deprivation and sleep loss.

### **3. Materials and methods**

The thesis will be written as a literature review following the principals of the IMRAD-method. A variety of relevant articles will be studied as secondary sources that do not report new or original experimental work.

### **4. Ethical aspects**

Considering the fact that all the sources are secondary, and the data is collected from previous articles and research, we expect that the ethical aspects have been taken into account. Our responsibility is to correctly refer to the used sources and to avoid plagiarism.

### **5. Process plan**

1. Week 13 – We will receive the issue for our thesis so the research process can begin, followed by a guidance meeting with Alette Bjorkum.
2. Week 14 – The first draft of the project plan will be handed in to be reviewed. Research will be done, along with a guidance meeting with Alette Bjorkum.

3. Week 15 – Start writing the theory part of the thesis.
4. Week 16 – Continue writing the theory part.
5. Week 17 – Continue writing the theory part.
6. Week 18 – In this week, we will conduct an in-depth review of previous research, with main focus on results and conclusion, and summarize the scientific articles and compare them with previous research. We will also conduct a progress rapport for our fellow students.
7. Week 19 – Continue the writing process as started in week 18. In addition, set up meetings for guidance of the process.
8. Week 20 – Prepare writing the abstract and introduction. We will continue open communication with both Dr. Basheer and Dr. Bjorkum and will work hard to achieve the goal, in the end of May.
9. Week 21 – Start finalizing the thesis and hand in the first draft of the bachelor assignment for guidance and correction (after handing in each section, section by section).
10. Week 22 – The last Zoom-meeting with Dr. Bjorkum 14:00, 05.26.2020 before bachelor submission 14:00, 05.29.2020.
11. Week 23 – Preparing for the oral examination that will be presented virtually through Teams or Zoom.
12. Week 24 – EXPO/ poster presentation at the Faculty has been annulated, however a poster as well as the thesis will have to be handed in as usual in Wiseflow.

## **6. Resources**

The thesis requires secondary sources through a variety of articles that discuss sleep and consequences of sleep deprivation. It will be written in collaboration with dr. Radhika Basheer from Section of Molecular Neuroscience, Laboratory of Neuroscience at Harvard Medical School, Department of Psychiatry at V.A. Boston Healthcare System, and dr. Alvhild Alette Bjorkum from the Department of Safety, Chemistry and Biomedical Laboratory Sciences, Faculty of Engineering and Science at Western Norway University of Applied Sciences.

## 7. References

- Besedovsky, L., Lange, T., & Haack, M. (2019). The sleep-immune crosstalk in health and disease. *99*, 1325-1380. doi:10.1152/physrev.00010.2018
- Bollinger, T., Bollinger, A., Oster, H., & Solbach, W. (2010). Sleep, Immunity, and Circadian Clocks: A Mechanistic Model. *56*, 574-580.
- Broussard, J. L., & Cauter, E. V. (2016). Disturbances of sleep and circadian rhythms: Novel risk factors for obesity. *23*(5), 353-359.
- Lorton, D., Lubahn, C. L., Estus, C., Millar, B. A., Carter, J. L., Wood, C. A., & Bellinger, D. L. (2007). Bidirectional Communication between the brain and the immune system: Implications for physiological sleep and disorders with disrupted sleep. *13*, 357-374.
- Mullington, J. M., Haack, M., Toth, M., Serrador, J., & Meier-Ewert, H. (2009). Cardiovascular, Inflammatory and Metabolic Consequences of Sleep Deprivation. *51*(4), 294-303.
- Weljie, A. M., Meerol, P., Goel, N., Sengupta, A., Keyser, M. S., Abel, T., . . . Shegal, A. (2015). Oxalic Acid and Diacylglycerol 36:3 are Cross-Species Markers of Sleep Debt. *112*, 2569-2574.
- Zhu, B., Shi, C., Park, C. G., Zhao, X., & Reutrakul, S. (2019). Effects of Sleep Restriction on Metabolism-related Parameters in Healthy Adults: A Comprehensive Review and Meta-analysis of Randomized Controlled Trials. *45*, 18-30.