A Behavioral Analysis of the Impacts of Chronic Sleep Deprivation

Olivia Cornelius, Aidan Girado, Chase Horton, Emily Miller, Natalie Storch, Lisa Lyons

Department of Biological Science, Program of Neuroscience, Florida State University, Tallahassee, Florida

INTRODUCTION

Sleep restriction during the work week is becoming an increasing problem. The National Sleep Foundation's 2008 Sleep in America Poll found that about half of adults working over 30 hours a week restricted their sleep to an average of 7 hours a night (Swanson, *et al.* 2011). To compensate for this lack of sleep during the average work week, adults will sleep in longer on the weekends. The restricted sleep during the workweek can cause cognitive impairment during the workday, such as problems with concentration and memory. One objective of our project was to develop a chronic sleep paradigm that mimics the sleep deprivation experienced during a five-day workweek. We sleep deprived animals five hours per day for five days using a gentle handling sleep deprivation protocol to prevent micro sleeps. Our studies examine the behavioral changes that occur with a chronic sleep paradigm. We hypothesize that the mice will become sleepier earlier in the day as the week goes on.

METHODS

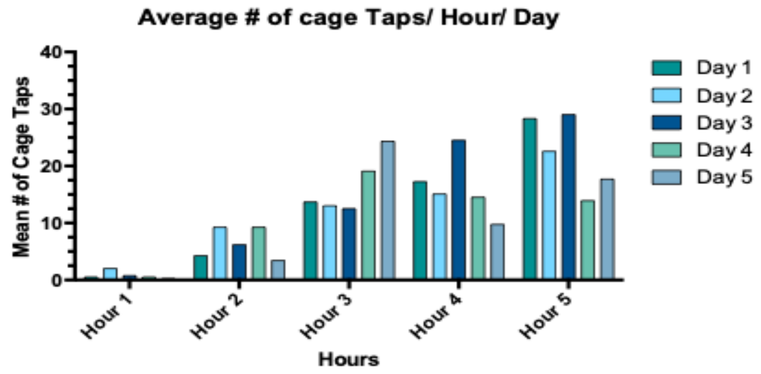
ANIMAL CARE

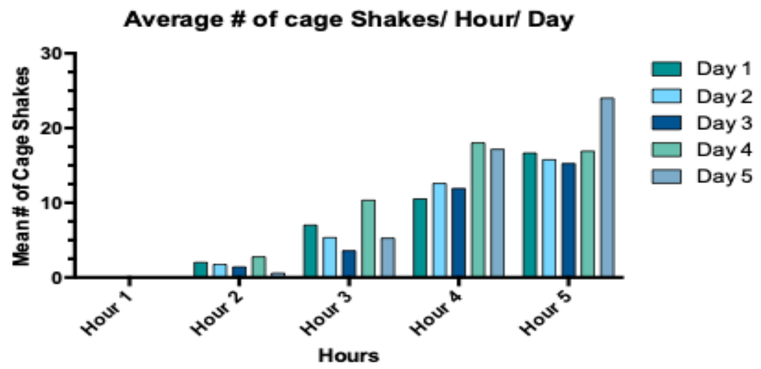
Male C57Bl/6J mice were housed in groups of four and were split into individual cages seven days prior to the chronic sleep deprivation. Housing contained water, food pellets, corn cob bedding, and shredded filter paper for nesting. After first chronic sleep deprivation, a transition from water bottles to water gel packs was made to prevent the dampening of their bedding. The damp bedding did not allow the mice to rest during their rebound sleep time, causing a significant increase in cage taps and shakes during the five-hour sleep deprivation period. Each day before the experiment, wellness checks occurred along with cage changes which ensured the mice remained healthy. Cage tapping began three days before the experiment, so the mice were accustomed to the noise and startle of the method of gentle handling used during the experiment.

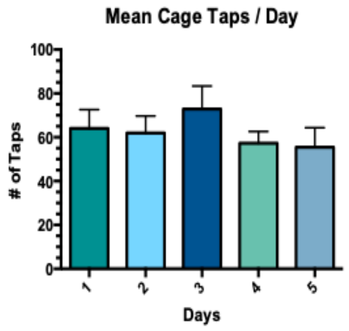
CHRONIC SLEEP DEPRIVATION

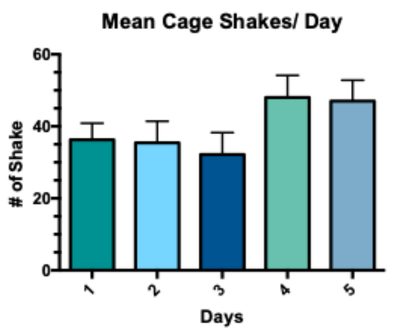
The period of chronic sleep deprivation lasted five days, each day for five hours. Because the light cycle was from 9 a.m. to 9 p.m., we started sleep deprivation at 9 a.m at the beginning of their rest period. The method used to ensure the mice did not fall asleep or undergo any periods of micro sleeping was gentle handling, which involves gentle shaking and tapping of their cages. The number of cage taps and shakes administered was quantified for each mouse. Cags taps are administered by a short series of knocks to the side of the cage when the mouse appears to initiate sleep. If the cage taps are ineffective, then several quick shakes are administered to the cage. When shakes are applied, taps are not counted on the tally. On the fifth day, immediately following sleep deprivation, mice were euthanized via cervical dislocation. Control mice were euthanized at the same time to avoid any circadian confounds. For future molecular studies, sample brain tissues from the hippocampus of each mouse were retrieved during dissection. For each dissection, brain tissues were flash frozen on dry mice. Two independent experiments were quantified with a total of 12 sleep deprived mice.

RESULTS









CONCLUSION

We hypothesized that the number of cage taps and shakes would increase earlier in the day as the experiment progressed. However, our results showed no significant change in behavior between each day of the experiment. This indicated that the mice were receiving adequate rebound sleep in between their sleep cycles.

FUTURE DIRECTIONS

Sleep deprivation is a topic of research that is crucial to study since it is so prevalent in everyday life. The more detailed and accurate information we can collect will allow us to discover possible treatment options. For future experiments, it can be useful to complete RNA analysis so we can discover the specific genes affected by chronic sleep deprivation. This can be done by performing RNA extractions and using gene expression analysis strategies like qPCR.

Future molecular studies visual flow chart

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