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From Bats to Obesity: Illuminating the Effects of Light Pollution


Short-tailed fruit bat in flight
source: Wikipedia Commons

At the 'La Selva' Biological Station in Costa Rica, a team of researchers led by Daniel Lewanzik of the Leibniz Institute for Zoo and Wildlife Research in Berlin investigated the effects of artificial light on the eating habits of Sowell's short-tailed bats. They tested to see how often bats retrieved food from a dark cave compared to one lit by a common sodium street lamp. The bats preferred the darkness over the artificially lit regions. Going further, Lewanzik investigated whether the bats harvested plants kept under a normal day/night cycle in contrast to plants illuminated with artificial light. The bats preferred 100% of the normal plants but only 78% of the artificially lit plants (Lewanzik). These bats serve a vital purpose in populating the local deforested regions of the rainforests with seeds, and their absence in artificially lit regions could have a negative effect on the growth of the rainforests.

While the effects of artificial light on fruit bats raise ecological concerns about the rainforests, they also raise important questions about the effects of artificial lighting on eating habits. In the cozy college town of Northfield, MN, far from the flying fruit bats of Costa Rica, sit two college campuses enveloping a small community and several students all surrounded by artificial lighting. What effects do artificial lights have on these students and how are their eating habits changing as a result?

Could artificial lighting be a cause of obesity among these college students or is there no evidence supporting this conjecture?

Let's first examine the factors influencing obesity. The Department of Health defines an obese person as someone with an excess of body fat and a person is often considered obese if their body mass index (BMI) reaches a certain percentile such as above the 95th percentile. The causes of obesity are

linked to a number of factors such as one's genetic background, environment, diet and metabolic rate (Sahoo 2015).

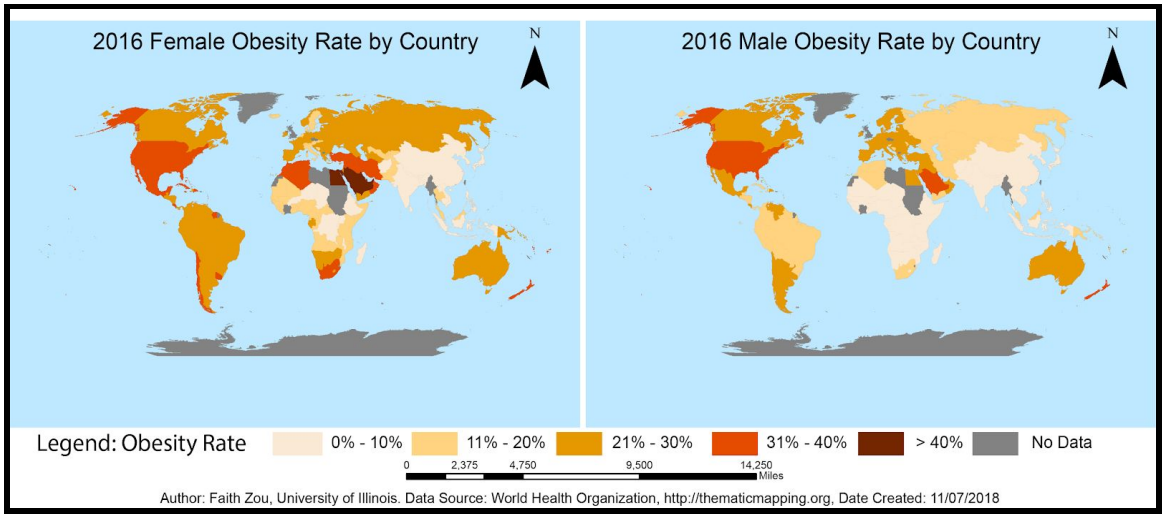
Recent research published in *the International Journal of Obesity* connects obesity with artificial light-at-night exposure. The three scientists who conducted the study took satellite images of night time illumination and data on obesity rates in different countries in order to see how they influence each other. Using statistical methods, they found that an increase in artificial light-at-night corresponds to excessive body mass in humans (Rybnikova 2016). This raises an interesting question: is there a more direct link between increases in body mass and artificial light?

One answer to this question lies in research published through *the Proceedings of the National Academy of Sciences,* which looked at effects of prolonged light exposure on mice. These researchers noticed a link between the suprachiasmatic nucleus (SCN), the master clock for both humans and mice, and increases of brown adipose tissue (BAT). The researchers exposed mice to artificial white fluorescent light for their studies and found that the prolonged light exposure increases the body fat mass through decreases in BAT activity. BAT is responsible for combusting high amounts of triglycerides into heat and this process expends a lot of energy (Kooijman 2015).

While both college students and mice are biologically similar (National Human Genome Research Institute, 2010), one might still wonder if this research really applies to humans as well. Although, it is much harder to monitor the exact artificial light exposure of college students, a 12 month study of 62 healthy pre-school children in Australia links light exposure to an increase in BMI. The researchers also provide previous data that BMI in the first five years of life helps predict BMI as an adult. From this study and data, it becomes clear that light exposure as children can influence BMI later in life (Pattinson 2016). While it cannot be shown that the mechanisms behind BMI growth corresponds directly to BAT activity in the children, the increase in BMI shows that both mice and humans with prolonged exposure to light gain more body mass.

What does this mean for small college campuses like those in Northfield, Minnesota?

The increased exposure to artificial lighting could lead to a literal increased mass of the student body. Research published in the *Journal of Nutrition Education and Behavior* examined the ways in which student BMI changed over the course of 4 years in college. They found significant increases in BMI, weight, and the overweight/obese categories over the course of the four years (Pope 2016). Not only does obesity seem to increase over the course of four years of college, but obesity rates in Minnesota have been on the rise as well. These rates have increased from 16.4% in 2000 to 28.3% in 2017 (Department of Health 2019). The impact of obesity is widespread. Obesity is linked to a numerous health-related issues



such as type-2 diabetes, hypertension, coronary heart disease, arthritis, and cancer. It also cost the state of Minnesota an estimated $2.8 million in 2009 (The State of Obesity 2018). On small campuses like St. Olaf and Carleton in Northfield, the health of the student body is a top priority. Administrators and educators should take light pollution into consideration. While the short-tailed fruit bats of Costa Rica enjoy eating in the dark, the same cannot be said for college students. Many students are attracted to a brightly lit campus, and the increased artificial light exposure could lead to an increased student body, in more ways than one.

References

Department of Health. (2019). *Obesity Quick Facts*. Retrieved April 17, 2019, from https://www.health.state.mn.us/people/obesity/quickfacts.html

Kooijman, S., van den Berg R, Ramkisoensing A, Boon M.R., Kuipers E.N., Loef M … Rensen, P. C. N. (2015), Prolonged daily light exposure increases body fat mass through attenuation of brown adipose tissue activity. *Proceedings of the National Academy of Sciences*, *111* (21), 6748-6753. doi: 10.1073/pnas.1504239112

Lewanzik, D. & Voigt, C. C. (2014), Artificial light puts ecosystem services of frugivorous bats at risk. *Journal of Applied Ecology*, *51* (2), 388-394. doi:10.1111/1365-2664.12206

National Human Genome Research Institute. (2010). *Why Mouse Matters*. Retrieved April 21, 2019, from https://www.genome.gov/10001345/importance-of-mouse-genome/

Pattinson C. L., Allan, A. C., Staton, S. L., Thorpe, K. J., & Smith, S. S. (2016). Environmental light exposure is associated with increased body mass in children. *PloS one*, *11* (1). doi:10.1371/journal.pone.0143578

Pope L, Hansen D, Harvey J. (2016), Examining the weight trajectory of college students. *Journal of Nutrition, Education, Behavior*. 2017 49(2):137-141.e1. doi: 10.1016/j.jneb.2016.10.014.

Rybnikova, N. A., Haim, A., & Portnov, B. A. (2016). Does artificial light-at-night exposure contribute to the worldwide obesity pandemic? *International Journal of Obesity, 40*(5), 815-823. doi:http://dx.doi.org/10.1038/ijo.2015.255

Sahoo, K., Sahoo, B., Choudhury, A. K., Sofi, N. Y., Kumar, R., & Bhadoria, A. S. (2015). Childhood obesity: causes and consequences. *Journal of family medicine and primary care*, *4*(2), 187–192. doi:10.4103/2249-4863.154628

The State of Obesity. (2018). *The State of Obesity in Minnesota.* Retrieved April 17, 2019, from https://www.stateofobesity.org/states/mn