Student: Fatoumata Jallow
Faculty Sponsor(s): Osman Yurekli and Ted Galanthay
Mathematics Department

Background: In 1974, obesity was identified as one of the most important nutritional diseases in the affluent countries of the world (Lancet 1974). Over the last three decades, obesity and overweight combined became a major global epidemic, all countries were affected regardless of their wealth or development status. The prevalence of overweight and obesity combined increases worldwide, by 27.5% from 857 million people in 1980 to 2.1 billion people in 2013. All age groups, ethnic groups and both genders were affected by obesity and overweight (U.S. Department of Health and Human Services, 2001). In US, two out of three adults were identified as overweight (NIDDK 2012). In 2011, 67.6% of US adults were identified as overweight and obese, where 33.7% of those were classified as obese (IHME 2014). Obesity is considered a high-risk factor for hypertension, type 2 diabetes, cardiovascular diseases, musculoskeletal disorders, osteoarthritis, hypercholesterolemia, and asthma (Hammond and Levine 2010, WHO 2015). In consequence, researchers in many disciplines (e.g. epidemiologists, nutritionists, economists, public health specialists and mathematicians) examined the factors behind obesity and how to prevent it by reducing its risk factors and altering its socioeconomic factors. It is hypothesized that trend of obesity should stabilize and plateau, independent of preventative measures, by 2030. The leading purpose of this research is to replicate the study done by *the Obesity Society* with more recent numbers and provide connections to the healthcare industry while also building the mathematical connection with the equations used to theorize the future of obesity prevalence. With intentions of providing a better perspective of how obesity prevalence would change in the current American society.

Methods: In this research, we will use the SIR model to examine transitions between normal weight and overweight (and obese) classes of people, where the body mass index (BMI) is used to classify each person. The S → I → R model is an epidemiological model that demonstrates the hypothetical number of people infected with a transmissible illness over a period of time in a closed population. In this case, the disease would be obesity. The S → I → R model will be used as the framework to display how people fall into obesity. The S → I → R methodology divided the population into two compartments, by representing BMI < 25 which was characterized as Susceptible and Exposed while BMI > 25 was organized into three groups (Overweight, Obese and Extremely Obese). For this model, particularly nothing was expected for the obesity prevalence. There was a baseline of how to approach the question effectively after showing how the process begins. Several factors such as biological factors, behavioral factors and social factors were implemented into differential equations which helped to predict a more realistic future outcome for obesity. Preventative strategies for obesity were independent of the research.

Results: Results demonstrated that the prevalence of obesity should level off in the span of twenty years. It was concluded that obesity should come to a plateau by 2030 at about 32%. The model also predicts that obesity prevalence is a function of birthrate and the environment one is born in. In relation to the factors that affect obesity, a higher birthrate delays the stabilization of obesity prevalence but decreases obesity prevalence. If one is born

in an obesogenic environment, then that individual has higher chance of becoming obese later on.

Conclusions: By concluding that the obesity prevalence will stabilize and plateau by 2030, independent of current preventative strategies, this trend provides important implications. Factors such as birthrate and environment plays an important role in the prevalence of obesity in the American population. With this conclusion, it provides a broader perspective on obesity and most likely with the addition of preventative strategies then that would bring a positive outcome. This could impact the healthcare industry and possibly give an estimate of what obesity will look like financially. Additionally, this baseline model that displays social, biological and behavioral factors can be extended to include other factors such as immigration, preventative measures and the validity of the Body Mass Index.

References

"Overweight and Obesity Viz." *Overweight and Obesity Viz*. Institute of Health Metrics and Evaluation, n.d. Web. 07 Mar. 2017.

Thomas, Diana M., Marion Weedermann, Bernard F. Fuemmeler, Corby K. Martin, Nikhil V. Dhurandhar, Carl Bredlan, Steven B. Heymsfield, and Claude Bouchard. "Dynamic Model Predicting Overweight Obesity, and Extreme Obesity Prevalence Trends." Ed. Eric Ravussin and Donna Ryan. *Obesity Science and Practice* 22.8 (2014): 590-96.

"Overweight and Obesity Statistics." National Institutes of Health. Ed. Cheryl Fryar and Cynthia Ogden. U.S. Department of Health and Human Services, Oct. 2012. Web. 07 Mar. 2017.

World Health Organization, (2015). Obesity and overweight: WHO Fact Sheet. No 311. January 2015. http://www.who.int/mediacentre/**factsheets/fs311/en/.**

Hammond RA. Levine R. The economic impact of obesity in the United States. Diabetes, metabolic syndrome, and obesity: Targets and Therapy: 2010; 3:1-11.
Lancet (1974); Editoria. Infant and adult obesity. Jan.5; 1(7845):17-8.