What is the Effect of Genotype on High Fat Food Consumption with Different Prices?

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**Background:** The obesity epidemic in America is becoming more severe each year. Between 1960 and 2003, the percentage of obese and overweight Americans almost tripled from 13% to 34% (National Institute of Diabetes and Digestive and Kidney Diseases). During this time, fast food restaurants and convenience stores have become ubiquitous across the country, while advancing technology and agricultural practices have allowed for foods to be cheaper and more available to the average consumer. Both have served as possible contributing factors to the growing obesity epidemic (French 2003). Since 1970, the per capita caloric intake has increased by 523 calories per person, per day to an average of 2,757 total calories (Golan and Waquiu 2005). This increasing food availability has lead to the trend of high sugar and high fat foods being cheap, readily available and easily consumed by the average person, regardless of socioeconomic status (Drewnowski and Specter 2004). Between 1970 and 2003, the consumption of fats and oils increased by 63%, grains by 43%, and that of sugars by 19%, while the average fruit and vegetable consumption only increased by 12% and 24%, respectively (Golan and Waquiu 2005).

The fact that high fat and high sugar foods are less expensive and more prevalent than fruits and vegetables has lead to higher obesity rates, especially among individuals of lower socioeconomic status (Drewnowski and Specter 2004; Salsberry and Reagan 2009). Consumer food choices are controlled by taste, cost and convenience and, in situations of deprivation, the human preference for energy-dense high fat and high sugar food functions as an advantageous mechanism for survival (Drewnowski and Specter 2004). In recent years there have been numerous government efforts to promote decreased consumption of fats and sweets and increased consumption of whole foods. However, due to the inverse relationship between energy density and energy cost, the advice to consume less energy-dense foods most likely has caused unintended financial strain on consumers (Drewnowski and Specter 2004). As a result, food prices continue to serve as an obstacle preventing long-term nutritional changes.

Studies of the consumption patterns of mice have shown that consumption rates decline as a particular food becomes more expensive and harder to procure. Mice, when given two food options of varying prices, are more likely to eat a greater amount of the lower priced commodity (Mathis et al. 1996; Chaney and Rowland 2008). Relating these findings back to the trend that food price decreases with increasing energy-density, it is clear to see why being of lower socioeconomic status could foster consumption of an unhealthy diet and lead to higher risk of obesity (Drewnowski and Specter 2004).

The relationship between food price, food availability and consumption patterns is clear. Now, greater attention needs to be put toward identifying exactly how food prices are affecting human food consumption patterns in order to correctly address the obesity epidemic. Also, one issue that has not been thoroughly addressed is whether human genetic differences affect food and economic choices. Our country is moving toward using taxation and subsidies to remove the cost discrepancies between energy-dense foods and nutrient-dense foods and promote healthier eating (Drewnowski and Specter 2004). However, the United States is a melting pot of individuals of differing genetic backgrounds. Currently, there is little research to show whether individuals of different genetic backgrounds make different food choices while facing similar economic conditions. Gaining a more thorough understanding of the relationship between genetics and economic food choices is essential to making more effective economic policy changes, as well as creating genetic-specific treatment plans for obesity and related diseases.

**Specific Aims:** This research project is designed to address the relationship between food price and consumption, specifically relating to the consumption of high fat food. The project is designed to test whether increasing the price of high fat foods will decrease consumption, and to test whether different genotypes of mice react differently to the changing food prices.

**Hypothesis:** Female mice, regardless of genotype, will decrease their consumption of high-fat mouse chow as the price of the food increases. Additionally, food consumption patterns will vary among different genotypes of female mice exposed to a high fat diet with uniform price requirements.

**Methods:** During the study, two different genotypes of obese-mouse models will be used: N2 Knock-Out and TUB-mutant, along with their wild-type counterparts (N= 2 females of each). Use of these models will help gain a better understanding of the consumption differences that may exist between different genotypes. At the start of the study, each mouse will be assessed for body weight by NMR (Nuclear Magnetic Resonance Spectroscopy) and genotype through the use of PCR (Polymerase Chain Reaction). Mice will be fed 20mg high-fat pellets (35% fat) through a single dispenser controlled by a lever (see Figure 1). A light will be used to indicate that the lever is active and the price of the food will vary between 10 to 50 lever presses per pellet. Each mouse will be exposed to four incrementally increasing prices for 4-7 days each or until consumption patterns become consistent. Body weight and food consumption (lever presses divided by price/pellet) will be monitored daily. Additionally, a vaginal swab will be taken daily to monitor any relationship between the female mouse estrous cycle and food consumption patterns. At the end of the fourth price schedule, body weight, body fat, and blood pressure will be assessed and a glucose tolerance test will be conducted. End values will be compared to initial values taken, or to established normal values for mice based on previously published research. Any mouse falling below 20% of their starting body weight will be immediately removed from the study.

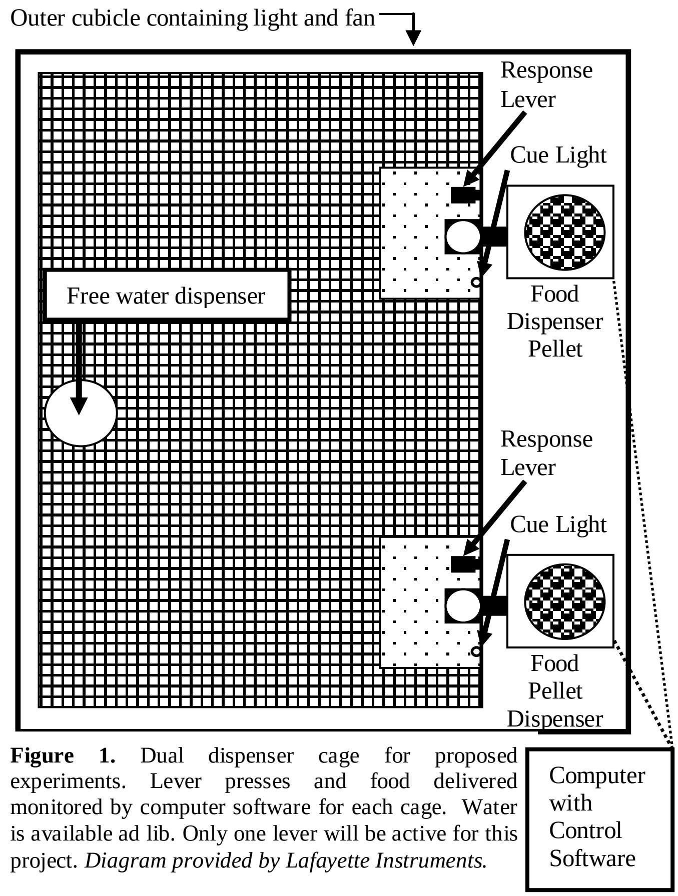


**Figure 1.** Dual dispenser cage for proposed experiments. Lever presses and food delivered monitored by computer software for each cage. Water is available ad lib. Only one lever will be active for this project. *Diagram provided by Lafayette Instruments.*

**<u>Future Direction</u>:** This study will be completed with hopes of future application to human studies, and eventually, economic policies. If the mice are more likely to decrease consumption with increasing prices of the high fat food, and if different genotypes of mice respond differently to price changes, then a supplemental study can be conducted to see if these relationships hold true for humans. An economic approach to fighting the obesity epidemic is one that has not been thoroughly addressed and could be the exact approach our country needs (French 2003). Increasing the price of high fat foods can serve to deter more people from consuming such high quantities of it. A supplemental decrease in price or subsidizing of whole foods, namely fruits and vegetables, can hopefully change food consumption trends in America and lead to slimmer waistlines! Furthermore, from this research human trials can be initiated to see if genetic differences affect food choice under various economic conditions. If differences do exist, this would establish and support the need for a genetic specific approach to fighting obesity in our society. With obesity rates on the rise, our country is in critical need of an innovative and effective intervention to reverse the trend and in turn, build healthier lifestyles.

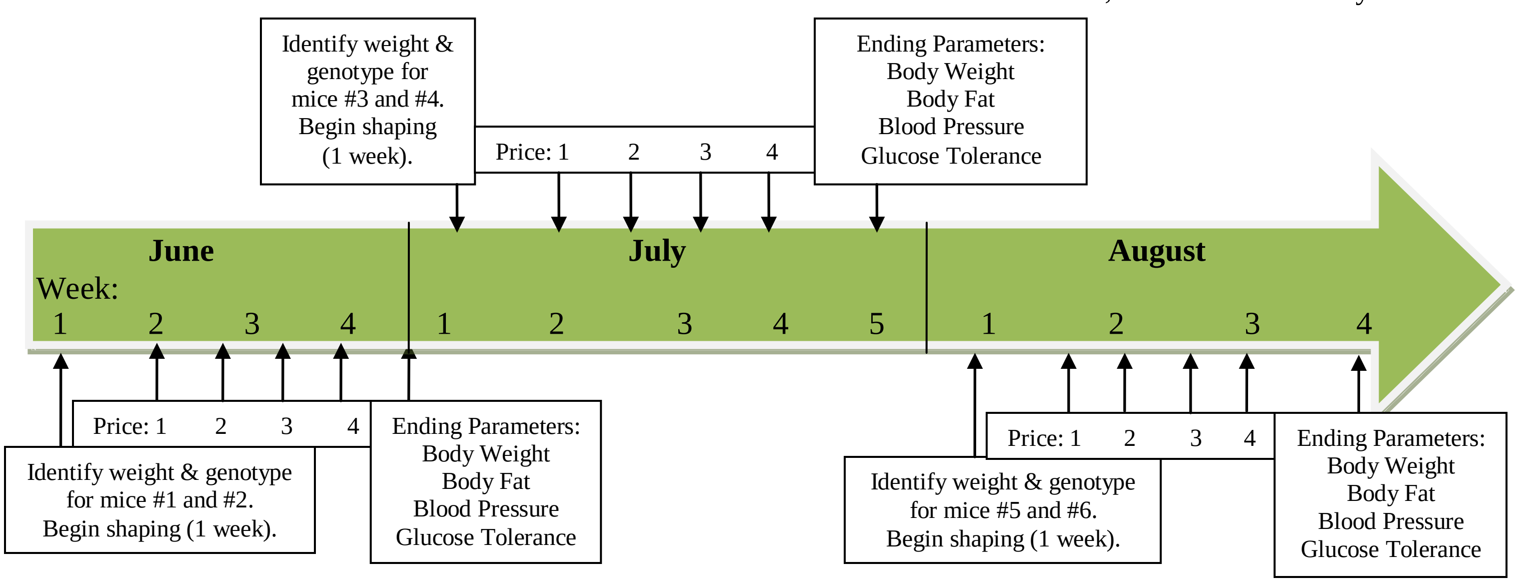


**Figure 2:** Timeline displaying the implementation of mice and price schedules for the project.

# References


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**Budget:**

| ITEM | TOTAL COST |
|---|---|
| **Materials** | |
| • **PBS solution** | **$20.00** |
| • **Cage cleaning supplies** | **$10.00** |
| • **High Fat Mouse Chow -1 bag of 100,000-20mg pellets.** | **$450.00** |
| • **Microscope slides** | **$3.95** |
| **Equipment** | |
| • **Operant Chambers (2)** | **$9072.00** |
| **Other** | |
| • **Mice housing-$1/day/box: 2 mice per day for ~70 days.** | **$140.00** |
| • **Glucose tolerance test strips (~90 @ $1.25 Each)** | **$112.50** |
| **TOTAL COST** | **$9808.45** |