The Ability to Discriminate Differences in Fat Content As a Predictor of Obesity in African-American Adults

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Personal Section

My interest in science began at a very young age. My grandfather would always engage me in discussions about why the world is the way it is. Whether the discussion was about the trees in my backyard, the way a toaster oven works, or the parts of the human brain, my mind was nurtured as a child to think critically about problems and how to go about finding their solutions. Essentially, this is the scientific method.

Every day, we use the scientific method, whether we know it or not. We ask ourselves questions, formulate methods to determine the answers to these questions, and make conclusions based on what we have discovered. Thus, we are all scientists.

My scientific inquiries began as a child and continued to develop throughout elementary school and middle school. By the time I entered high school, I was questioning everything around me. I wanted to know exactly how everything in the universe worked. But, I was most interested in why people behave the way that they do. Why are some people compassionate and others violent? Why are some people thin and others overweight? The human body is an extremely complex machine, with an infinite number of factors playing a role in why we are the way we are. There is no possible way of solving the mystery of human behavior, but as a fourteen year old boy, I wanted to learn how to go about solving part of the mystery of the psychological and genetic behaviors of humans.

The Advanced Science Research program was started at my school to give students the opportunity to perform independent science research under the supervision

of a mentor on a topic of their choosing. After attending an informational meeting about the program, I knew that this was the program that could facilitate my investigation of human psychology.

America has become a country of excess, especially in regards to food. So, when I decided to narrow down my research interests to a branch of human psychology, obesity was the logical choice. In the last fifty years, the percentage of obese Americans has nearly tripled. And, now in 2008, more than half of all Americans are classified as being overweight (1)

Before my project began, I first contacted several researchers in the New York City area who specialize in obesity research. I received a response from Dr. Kathleen L. Keller at the New York Obesity Research Center, who agreed to mentor me. After meeting with Dr. Keller, I determined that the best study to work on was a study involving African-American subjects and the investigation of the causes of obesity (besides basic intake of high-fat foods). African-Americans is the ethnicity that has the highest prevalence of obesity and also have been shown to suffer more from the related health risks of obesity (2). Thus, when investigating the causes of obesity, African-Americans are the logical place to begin.

In this study, three possible causes of obesity were investigated. The first was the link between obesity and fat discriminability, the ability to discriminate differences in fat content. The second potential cause was sensitivity to 6-n-propylthiouracil, a compound that varies in sensitivity based on variations at the Tas2R38 gene. And the third potential cause was the possibility of "tasting" fat, as controlled by the CD36, a candidate fat taste receptor that is found on the tongue.

But, before I could begin research, there was a large amount of background information that I had to learn, not only about the science behind obesity but also about the mathematics involved in the study. The large majority of the science research community, especially those involved in human subjects research, use the statistical analysis program SPSS to both organize data sets and run statistical tests. The most important thing that I had to learn in regards to SPSS was the idea of significance. High-level research is not based on the frequencies of different variables but rather on the relationships between different variables and factors measured in the experiment. The strength of these relationships is shown by a p-value. Human subjects research most often uses a significance cutoff of $p \leq .05$ (The closer the value to zero, the more significant it is).

The bulk of the mathematical statistics work that I did involved running bivariate correlations and looking at scatter plots of these relationships. A scatter plot is a graph of all subjects in the study with a regression line, or best-fit line, shown. This line is representative of the relationship between the two, or more, variables being looked at.

All of this background can be read in books, but when I was working with the data that I collected from subjects who I recruited and tested, all of the statistics came alive for me and seemed increasingly important. I felt like the data I had obtained and analyzed really meant something because it did. The findings that I produced were novel and contribute to the research of the field so one day the problem of obesity will lessen.

As a high school researcher, I believe it to be very important to have a solid background in statistics and the methodology of science research before beginning an independent study. The ultimate goal of research is to contribute to the literature and

understanding of a field. This is only possible if the methods used to conduct the research are the same across all experiments. Repeatability and reliability of research are really more important than what the experiment is even looking at. And thus, background knowledge about research and statistics is very important.
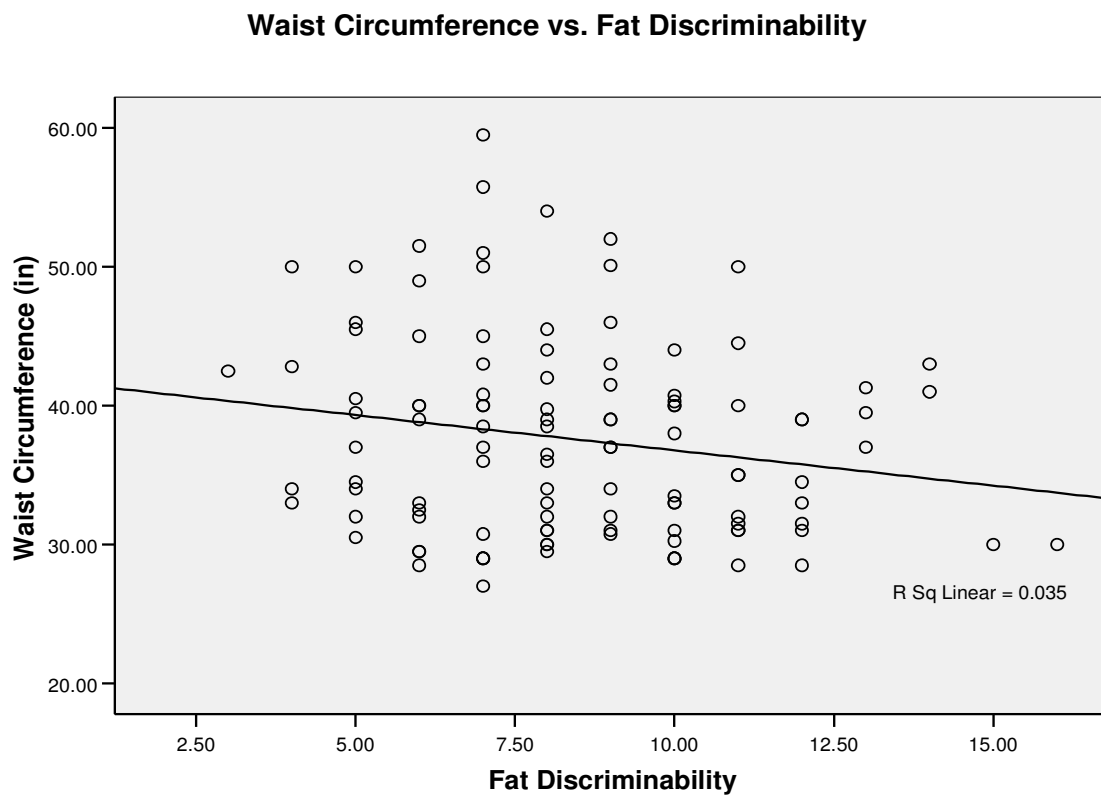
The process of preparing to conduct my research, collecting my data, entering the data, analyzing the data using SPSS, and writing a manuscript of my findings took less than a year. But, in that short period of time, the knowledge I learned was extensive and the skills are things that will help me in the future. Learning to run a scientific study, analyze relationships, and write in a thorough but clear manner have taught me a lot. I was very lucky to have the experience of performing research in high school.

Research Section

The major cause of obesity is absolutely the intake of high-fat foods. This, in combination with a lack of exercise, has made America the world leader in people who are overweight or obese. However, research is now showing that there may be other links to obesity, from genetic interactions to psychological conditions. Research has shown that humans may have the ability to "taste" fat, much like they taste the flavors sweet, salty, sour, bitter, and savory. The CD36 gene, present in the taste cells has been shown in rats (3) and humans (4) to act as this fat taste receptor. Further, sensitivity to a compound, 6-n-propylthiouracil (PROP), has been shown to relate to increased sensitivity to certain foods, potentially fat (5). In the study that I conducted, I investigated three separate factors: the ability to discriminate differences in fat content (fat discriminability), sensitivity to PROP, and variations at the CD36 allele.

My study was comprised of 113 healthy African-American adults. These subjects were of a wide range of ages and weights. Each subject was tested for one hour. Their sensitivity to PROP (using a salt reference solution) was determined along with a measure of their fat discriminability, how good or bad they were at telling the difference in fat contents in various Italian salad dressings. Saliva samples were also collected to determine CD36 variations.

Once the data collection ended, it was my job to assess the relationships I had found. The first relationship that I found in my data was a negative relationship between waist circumference (obesity) and fat discriminability score. This is shown in the scatter plot below. The negative relationship shown hear means that as subjects were more

Waist Circumference vs. Fat Discriminability

obese, they were worse at telling the difference in fat content. As subjects were leaner,

they were better at telling the difference. This relationship did meet the significance cutoff, with a p-value of .049. This is a key finding and is something that has never been published before.

The next statistical test that I ran was to see if PROP sensitivity played in a role in the original relationship. I hypothesized that PROP sensitivity would play a role in the relationship because PROP sensitivity had been shown in the past to be linked to increase sensitivity to things like cream and chili pepper. The scatter plot of this finding is shown below. The best-fit line here is almost identical to the best-fit line from the previous

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scatter plot. This means that PROP rating did not play a role in the relationship, as I had expected.

The findings from the CD36 portion of the study are currently being worked on. The DNA samples have been collected but the data is still being analyzed.

As I discussed before, the ultimate goal with this study was to determine which populations are more susceptible to obesity. Thus, in the future I would like to firm up the methods that I used, and more specifically determine the causes of obesity. Eventually, once the causes are determined, I hope to develop a regression model to predict obesity in future subjects, based on a variety of genetic testing and phenotyping (Italian salad dressing taste tests like those performed here).

There are a number of different conclusions which can be drawn my research. But I believe that the most important one is that there are definitely other causes of obesity besides the intake of high-fat foods. This research definitely warrants further investigation in the future.

If there is one most important thing that I learned from my research, it is that no finding can be proven and what is predicted almost always never is found to be exactly how it was predicted. All findings must be strengthened by future investigation, repeating experimental methods, revising steps, and re-analyzing data.

The problem of obesity won't be solved by one person's research or one revision of methodology. But by constantly rethinking approaches to research and using all available resources, hopefully one day we can actively fight the epidemic of obesity.

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