Investigating Relationships in the FLASH Pilot Study for STRIDE

A Senior Project

presented to

the Faculty of the Statistics Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science

by

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This document will serve as a summary of all of the work that Mathew Adams, Katrina Jackson, and Andy Zbin have done for STRIDE’s FLASH pilot study. We will begin by providing a brief background on the STRIDE program and FLASH studies. We will then go into more detail on the questions and variables of interest to the study. Next, we will describe our data cleaning process, the analysis we ran, and interesting results. Furthermore, we will share our experiences from events such as Hands on Health and the 24th Annual CSU Research Competition. We will conclude with a brief discussion of FLASH plans for the future.

We began working over the summer of 2009 as student research analysts for the STRIDE (Science through Translation Research In Diet Exercise) program at Cal Poly. This multi-disciplinary project employs over 250 students representing 5 colleges from 11 majors. Among other projects, STRIDE has inspired the FLASH study. FLASH is a large scale research project aimed towards examining the health of college students and their perceptions about personal health. There are a few main theories that prompted such a research project. The first is that overweight and obesity rate for high-school seniors is 25% while it is about 70% for adults. Another is that patients are given adequate tools and information to assess their own physical health status. And a third is that Californians are healthier than the rest of the nation. These theories are assumed to be true while there is no real data to support them. This study aimed to test these questions and more by studying student’s health on campus.

There were several studies conducted throughout the past years, each one evolving based on findings from the previous one. The initial study was conducted in the spring of 2008, with follow up samples taken in the winter and spring of 2009. In each of these samples, students were asked to estimate health measurements through a questionnaire before they were actually measured during a physical assessment. The 2008 pilot study survey included questions about
In the FLASH Pilot Study for STRIDE, we investigated relationships in demographics, perceived measurements, medicine, smoking, diet, alcohol, exercise and sleep. The 2009 pilot studies included all of the 2008 questions but also added additional questions about vegetarianism, dietary supplements, sedentary behaviors, marijuana, and binge drinking.

During the summer, we attempted an initial data cleaning for Winter/Spring 2009. This included running Proc Compares in SAS to address the dual-key entered data. Obvious outliers were evaluated and some imputation strategies were used. Then an initial Analysis on the 2009 data began, as we were interested in combining the 2008 and 2009 data sets. After extensive investigative analysis and data comparisons, we felt comfortable combining these data sets and began to run the bulk of our analysis. We used Binary Logistic Regression. We did consider Ordinal Logistic Regression; however, the decision was made in the end to only use binary logistic regression because of client goals and preferences. Through this analysis, we built a model for each possible predictor of BMI. We explored interaction and included the covariates of gender and race.

We were also given the opportunity to participate in several events that allowed us to gain experience in presenting research findings in an academic setting to a large audience. In order to do this, we updated previously submitted abstracts, were involved in poster creation and collaboration, and each gave a 15 minute presentation. The titles of these presentations are:

- What We Have Done and Where We Are Going (Katrina Jackson)
- Students’ Overweight and Obesity Rates and Undiagnosed Hypertension (Mathew Adams)
- Health Perceptions of Cal Poly Students (Andy Zbin)

Next we entered the state-wide research competition involving all the CSU campuses. Here we submitted a report on our FLASH research and gave a 15 minute presentation to a review committee. We then participated in a follow-up question and answer session. All of the slides
from these presentations and more are included in the appendix of this document for consideration and reference. Much of the visual representations we used are included as well.

Our next step was to combine 2008 & 2009 data sets. We compared the demographic breakdowns and then explored our first analysis of new 2009 variables. Before we could do this however, we had to execute an in-depth data cleaning process of both 2008 & 2009 data sets because the hard copies of all the questionnaires were finally found. After combining all three pilot studies, we performed a Logistic regression predicting BMI and a separate Logistic regression predicting Blood Pressure. For this second one, we added covariate Year in School to our models. We then assisted in the development of an abstract concerning the new Blood Pressure logistic regression.

Some of the most interesting results we have found are summarized in two abstracts that were accepted for poster presentation at the Obesity Society’s Annual Scientific Meeting in 2009. The first was entitled “Are California Undergraduate College Students Really Healthy? Undiagnosed Hypertension and Overweight/Obesity”. The basis for this abstract came from national survey data in 2000 that indicated 35% of college students were overweight or obese, with lower rates reported in a predominantly white student population (21.5%, 2003). Furthermore, there is a common perception that California college students are healthier in comparison to the rest of the nation, yet little data have examined this concept. The following results from the study were reported in the abstract. Of the 911 students, we had 523 males (57.41%) and 388 females (42.59%). The race breakdown was 74.86% White, 10.21% Asian, 6.26% Hispanic, 0.99% Black, and 7.69% indicated multiracial or other. The median age was 19 years old, with at least half the sample being between the ages of 18 and 20 years old. The BMI ranged from 16.0-49.3 kg/m^2, with 25.69% overweight (25-29.9 kg/m^2) and 5.27% obese.
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(greater than 30 kg/m²). In men, overweight/obesity prevalence was lowest in freshman
(30.42%) and increased as their year in school increased, with 2nd years at 39.74%, 3rd years at
52.73%, and 4th year and above at 55.17%. In females, overweight/obesity prevalence was fairly
similar across all years with first years at 22.34%, second years at 20.41%, third years at 28.00%
and fourth years and about at about 28.13%. Undiagnosed pre-hypertension or hypertension was
common in overweight and obese men with 82% meeting the criteria of having a systolic blood
pressure above 120 or having diastolic blood pressure above 80. Among the 193 overweight and
obese men, 60.1% were pre-hypertensive (systolic 120-139 or diastolic 80-89 mmHg) and
19.2% were hypertensive (systolic ≥140 or diastolic ≥90 mmHg). In contrast, blood pressure
was elevated in 61.5% of normal and underweight respondents. Among females, 33.8% had
elevated blood pressure with the split of 32.2% being pre-hypertensive and 1.6% being
hypertensive. Blood pressure or glucose regulating medication use was reported by less than 1%
of respondents. In conclusion, more than one third of this California college-aged population was
overweight or obese, with rates in males being much higher. These findings are noteworthy due
to the fact that obesity is a significant contributor to cardiovascular disease.

The second abstract was entitled “Undergraduate College Students: Perceptions of Their
Health Status”. The medical community promotes simple health screening tools, such as BMI
and waist circumference, for individuals to independently assess their weight status and
associated disease risk. These methods all require accuracy to produce reliable information.
Furthermore there is a common belief among many members of the medical community that
college aged young adults are very aware of these health indictors and know how to measure
themselves. We wanted to find out just how knowledgeable young adults really were regarding
their weight, health status and screening tools. We found that students were easily able to
investigate their weight with 98.7% giving estimates and that 86.6% could accurately estimate their measured weight within 5%. All respondents were equally likely to report height with 99.1% giving estimates. A much lower percentage of respondents were able to report other measurements such as waist circumference at 87.4%, BMI at 32.4%, and blood pressure at 28.9%. Respondents were asked to answer a question regarding their perceptions of their health status. Among the 34 obese men, only two identified themselves as ‘very overweight’, while most of them incorrectly stated that they were ‘slightly overweight’ at 76.4%. Many obese women thought they were only ‘slightly overweight’ at 42.82% while 50.00% correctly reported that they were ‘very overweight’. Only half of overweight and obese students recognized they were in fact overweight at 55.7%. Regarding health status, students replied: 11.0% ‘excellent’, 40.9% ‘very good’ and 38.8% ‘good’ for a combined 90.7%, yet 31.0% were categorized as either being overweight or obese. What we found was that students could accurately estimate their weight, but in general don’t know their BMI or blood pressure, nor could they recognize health risks. Also, we found that male overweight and obese students underestimate their weight status.

Furthermore, we co-authored another abstract submitted to the American Heart Association Joint Conference: The 50th Annual Epidemiology and Prevention Council & Nutrition, Physical Activity, and Metabolism Council. This abstract was entitled, “Is College fattening? Examining the increased prevalence of obesity in college years” and summarizes many more of our findings. We have also presented our initial findings of the 2008 data at Cal Poly’s Hands on Health Symposium in the fall of 2009.

Through all of our work and the involvement we had with the study, we were invited to work on a team to help modify and improve the next version of the questionnaire. Through the
success of the pilot studies, the baseline for a longitudinal study was done in the fall of 2009. This expanded survey includes over 100 questions. They have already collected a sample size of over 1400 respondents and are currently collecting another sample for spring 2010. FLASH is growing bigger by the day. The statistics department first became involved with FLASH when a senior a few years back took it on as a senior project. Since then there have now been 7 other statistics students who have had the opportunity to share in this amazing experience. Also, more faculty members have been brought on to oversee the work and give their valuable inputs as well.

Future work includes analyzing questions in the 2009 questionnaire that were not among the original 20 questions from the 2008 study. Some of the new questions include descriptions of TV/video game/computer usage, regularity of full nights of sleep, use of supplemental vitamins, regular breakfast consumption, and fruit and vegetable consumption. In fall 2009 and spring 2010, STRIDE began a new longitudinal survey, which is a comprehensive look at the way students define their weight and body as well as how they define their lifestyle and the choices they make daily. The new study is a completely new design, in which participants fill out an online questionnaire so that we can omit the problematic step of data entry by individuals who are not tied to the data. After a respondent has completed the first step of finishing the lengthy survey of over 100 questions, they will be approved to partake in a physical assessment. A team of trained students will take their body measurements as they did in the previous pilot studies. In the fall of 2009 the pilot study of these 100 questions was administered and we received 1520 survey respondents and 287 of these respondents completed the physical assessment. We will hopefully begin to analyze this new data very soon.
Every step along the way we were working with Professor Heather Smith and Dr. Ann McDermott. We were in constant contact with these two, especially when we had important decisions to make. Eventually we set up a regularly occurring meetings so that we were all constantly on the same page as far as the next phase of analysis and what needed to get done by when. We created a countless number of memos for documentation as requested by our client, Dr. McDermott. They are not included here because they are all very extensive and it would not be feasible to incorporate them into this report.
APPENDIX:

<table>
<thead>
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<th>Description</th>
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<td>2009 Submission for The Obesity Society (TOS) Conference</td>
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<td>2010 Submission for The American Heart Association Joint Conference</td>
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<td>Katrina’s Hands on Health Presentation</td>
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<td>Andrew’s Hands on Health Presentation</td>
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<td>Our CSU Research Competition Presentation</td>
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Background: The medical community promotes simple health screening tools, such as BMI and waist circumference, for individuals to independently assess their weight status and associated disease risk. These methods all require accuracy to produce reliable information. We wondered how knowledgeable young adults were regarding their weight, health status and screening tools.

Methods: Data are from the Cal Poly Flash Study: a rapid health assessment project involving undergraduate students at a four-year public university. In Spring 2008, self-selected students from three general education health classes were evaluated by standardized research methods. Objective data included weight, height, BMI, waist, blood pressure. Perceived weight, height, waist, BMI, health status, demographics were collected.

Results: Data were collected on 479 students (M: 57.5%; Wh-71.5%, As-13.0%, H-7.5%, B&O-8.0%), median age: 19y (IQR: 19-20y). Students were able to estimate their weight (M: 98.6%; W: 97.5%) that accurately reflects measured weight within 5% (86.4%, n= 414/479). All were equally likely to report height (98.8%), but men overestimated height by 0.6%.

BMI: Most were unable to report their BMI (68.5%, n=151/479). Underweight/Normal Weight students more often replied ‘don’t know’ (OR: 1.6, CI: 1.1-2.3 p=0.028) vs. Overweight/Obese (OW/OB). Also Overweight/Obese (OW/OB) students overestimated BMI (mean difference between Perceived BMI & Actual BMI: .57 ± 14.54 kg/m²). Versus men, women were twice as likely to estimate BMI (M: 26.1%; W: 38.9%; OR: 1.81, CI: 1.2-2.7, p=0.003), but fewer women estimated waist circumference (M: 96.0%; W: 80.1%, p< 0.001).

Weight status: OB men (n=21) never identified themselves as ‘very OW’; most incorrectly stated ‘slightly OW’ (81%, n=17). Most OB women thought they were ‘slightly OW’ (54.5%); and one-third (n=11, 36.4%) reported correctly. Only half of OW students recognized they were OW (55.0%). OW (44.3% of BMI 25-29.9, n=140) and NW/UW students (74.9% of BMI 18.5-24.9, n=307) felt they were the ‘right weight’.

BP: 70% of men and women were not able to estimate both their systolic and diastolic blood pressure (BP). Regarding health status, students replied: 51% ‘excellent/very good’ and 39% ‘good’; yet 36% had BMI ≥25.

Conclusions: Students accurately estimate weight, but don’t know their BMI, BP nor recognize health risks. College men overestimate height and, along with OW/OB students, underestimate their weight status. How can the college years become ‘teachable moments’ to improve personal health knowledge?
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2009 Submission for The Obesity Society (TOS) Conference
Category- Population Studies: Are California Undergraduate College Students Really Healthy? Undiagnosed Hypertension and Overweight/Obesity.

Ann Yelmokas McDermott, Kris Z. Jankovitz, Heather Smith, Sunny Atchison, Hsiangwei Kung, Oliver M. Mead. Cal Poly San Luis Obispo, CA

Background: In 2000, national survey data indicated 35% of college students were overweight or obese, with lower rates reported in a predominantly white student population (21.5%, 2003). A common perception is that California college students are healthier, yet little data have examined this concept.

Methods: Data were used from the Cal Poly Flash Study: a rapid health assessment project involving undergraduate students at a four-year public university. In Spring 2008, self-selected students (n=479) from three general education health classes were evaluated within seven hours by a student assessment team trained in standardized research methods measured weight, height, BMI, waist circumference, resting pulse and blood pressure. Participants reported medication use and demographics.

Results: Data were collected on 479 students (M: 57.5%; Wh-71.5%, As-13.0%, H-7.5%, O-8.0%), median age: 19y (IQR: 19-20y). BMI ranged from 16-39 kg/m², with 29% overweight (OW: 25-29.9 kg/m²) and 7% obese (OB: ≥ 30 kg/m²). Men were more likely to be OW/OB than women (41.67% vs. 28.08%; p = 0.002). Also, the odds of being OW/OB differed by class year controlling for gender (p = 0.016). In men OW/OB prevalence was lowest in freshman (n= 47/151, 31.1%) and greatest in upper-classmen (SO: 24/52, 46.2%; JR: 24/39, 61.5%; SR+: 20/34, 58.8%). In females, OW/OB prevalence was lowest in Seniors and Post Grad students (5/21, 23.8%), but similar across grades (FR: 39/137, 28.5%; SO: 9/20, 31.0%, JR: 4/16, 25.0%).

Large waist circumference (M: ≥ 40 inches; F: ≥ 35 inches) was found in 1.5% of men and 4.9% of women, even though OW/OB rates were much lower in women. Undiagnosed pre-hypertension (PreHT) or hypertension (HT) was common in OW/OB men with 82% meeting the criteria. Among 115 OW/OB men, 66.1 % (n= 76/115) were PreHT (systolic 120-139 or diastolic 80-89 mm Hg) and 15.7% HT (n= 18/115; systolic ≥140 or diastolic ≥ 90 mm Hg). In contrast, BP was elevated in only 63.4% of normal and underweight men (n=102/161; PreHT: n= 95, HT: n= 7). Among females, 35.5% had elevated blood pressure (PreHT: n= 70/203, 34.5%; HT: n= 2/203, 1.0%). BP or glucose regulating medication use was reported by <1% of men (n=2), no women.

Conclusions: More than 1/3 of this California college-aged population was overweight or obese, with rates in males being much higher. Similarly, obesity-related comorbidities were prevalent and undiagnosed. Future research must examine how college life influences health status and how best to improve health in this setting.
Investigating Relationships in the FLASH Pilot Study for STRIDE

2010 Submission for The Obesity Society (TOS) Conference
Title: Elevated Blood Pressure and Obesity: California Undergraduate Students at Risk

Authors: Ann Yelmokas McDermott, Kris Z. Jankovitz, Heather S. Smith, Aydin Nazmi, Mathew R. Adams, Katrina J. Jackson, Andy J. Zbin San Luis Obispo, CA

Background: Previous research suggests college students are healthier than other young adults, but most analyses rely on self-reported data. Studies employing physical assessments are needed to guide future interventions.

Methods: The Cal Poly FLASH College Study, a health assessment of undergraduates, was conducted in 2008-2009. Self-selected students (n=911) completed surveys, plus standardized methods were used to assess height, weight, body mass index (BMI), waist circumference, and blood pressure.

Results: Participants were 57% male and 75% white. Median age was 19y (IQR:18-20). BMI ranged from 16-49 kg/m2; 26% were overweight (OW) and 5% obese (OB). Males (37%) were more likely than females (23%) to be OW/OB; rates increased by class year and differed by race (all p<0.05). Less than half (46.5%) of students had normal BP (SBP<120 and DBP<80 mmHg), 45.7% were pre-hypertensive (SBP 120-139 or DBP 80-89), and 7.8% were hypertensive (SBP≥140 or DBP≥90). Males (31.9%) were half as likely to be normotensive compared to females (66.2%). Among males and females with BMI ≤ 24, 38.5% and 70.9% were normotensive, respectively. Corresponding rates of normotension in students who were OW/OB were 20.7% and 50.6%, respectively (p<0.05). Among freshmen, 39% of males and 67% of females were normotensive vs. 20% and 64% of non-freshmen males and females. Few ate ≥ 5 fruits/vegetables/day (5.8%), while 29.6% exercised ≥ 5 days/week.

Conclusions: Elevated BP was very common, especially among males, and patterns differed by sex, BMI and class year. College students exercise, but neglect fruit/vegetable intake necessary for vascular health.
Obesity is the most significant modifiable contributor to cardiovascular disease morbidity and mortality. Widespread national efforts to curb the obesity epidemic have proven largely ineffectual. In the US, prevalence of overweight and obesity is about 25% in high-school seniors; in adults it is nearly 70%. From 1971 to 2006, when obesity rates in most age groups doubled, obesity in 18-29 year-olds more than tripled, from 7% to 24%. Yet the period of emerging adulthood (late teens to mid-20s), marked by the adoption of new behavioral patterns and biological risk profiles, remains vastly understudied. As part of a pilot study, overweight/obesity prevalence was examined in a sample of undergraduate students aged 18-25 years at a four-year public university. Mean (SD) age of the 903-student sample was 19.2 y (1.3), 76% (690 of 903) were white, and 43% (386 of 903) were female. Most (68%, 614 of 902) were freshmen, 14% (127 of 902) were sophomores, and the remainder were juniors or higher. Mean (SD) body mass index (BMI) in women and men was 21.3 kg/m² (4.0) and 25.8 kg/m² (4.9), respectively. Seventeen percent of women (67 of 386) and 54% (277 of 517) of men were classified as overweight or obese (BMI > 25.0 kg/m²). In women, BMI values were relatively stable in freshman, sophomores, and juniors or higher; 21.2, 21.6, and 21.2 kg/m², respectively (p=0.8 for trend). In men, mean BMI increased from 25.3 kg/m² in freshmen to 26.1 kg/m² in sophomores, and to 26.9 kg/m² in juniors or higher (p=0.01 for trend). When adjusted for race/ethnicity, self-reported health, dietary behaviors and physical activity, each increase in class year (freshman, sophomore, junior+) was associated with a 3.0% (95% CI 1.0-5.1) increase in BMI, equivalent to nearly 0.8 kg/m² per year of college (p=0.003). Several well-described risk factors for weight gain including psychosocial stress, insufficient sleep, poor diet and food environment, and physical inactivity levels are highly prevalent in the university setting. Research suggests that emerging adults may be more receptive to intervention strategies compared to younger groups and middle-aged adults. Identifying behavioral risk factors specific to this life phase and implementing university-level interventions could therefore contribute to more effective long-term prevention strategies by curbing behavioral risk earlier in life, before the onset of overt disease, and in a group that may be more amenable to behavioral modification.
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Katrina’s Hands on Health Presentation

**Purpose**
- Three Main Theories:
  - National average for college-aged obesity: 35%
  - Californians are healthier than other states
  - The medical community gives adequate tools to patients to allow them to know their own physical health status.

**Data Collection**
- Self-selected students from 3 general health classes were tested during a single testing.
- Some of the subjective perceptions asked of the students that were then measured by trained students:
  - Weight
  - Height
  - BMI
  - Waist Measurement
  - Blood Pressure
Investigating Relationships in the FLASH Pilot Study for STRIDE

**Data Entry**
- Dual Key Entered
- Benefits:
  - The two enterers act as a check for correctness of the other
- Problems:
  - Missing Values treated Differently — N/A
  - Weight of eldest entered by both enterers — 168.8 lbs.
  - Gender Left Blank — Removed the observation

**Data Analysis**
- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year in School</th>
<th>PostGrad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>High Norm</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Low OW</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>High OW</td>
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<td></td>
<td></td>
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<tr>
<td>OB1</td>
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<tr>
<td>OB2</td>
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<td></td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Data Entry**
- Age Breakdown of the 479 students:

```
18 and Younger 16.0%
18-19  45.6%
20-21  22.8%
22 and Older 16.6%
```

**Data Analysis**
- For Example:
  - The variable for Year in school:

<table>
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<tr>
<th>BMI Level</th>
<th>Year in School</th>
<th>Controlling for Sex: Male (n=276)</th>
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<td>5</td>
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<td>High OW</td>
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</tr>
<tr>
<td>OB1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Total</td>
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**Data Analysis**
- For Example:
  - The variable for Year in school:

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<tr>
<th>BMI Level</th>
<th>Year in School</th>
<th>Controlling for Sex: Female (n=203)</th>
<th>PostGrad</th>
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<td>Total</td>
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</table>

**Data Analysis**
- BMI Level
- Level Name
- BMI Range
Investigating Relationships in the FLASH Pilot Study for STRIDE

**Data Analysis**

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
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</table>

Controlling for Race=White (n=343)

- For Example:
  - The variable for Year in school:

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<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
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<tr>
<td>Low OW</td>
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<tr>
<td>High OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Controlling for Race=Hispanic (n=36)

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Controlling for Race=Asian (n=62)

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Controlling for Race=Black (n=3)

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Controlling for Race=Other (n=35)

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High OW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Controlling for Race=Other (n=35)

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
<th>Post Grad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under/Normal Weight</td>
<td>1 2 3 4 or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight and Obese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Investigating Relationships in the FLASH Pilot Study for STRIDE

Data Analysis

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BM Class</th>
<th>Year In School Collapsed Controlling for Age (n=513)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underweight and Normal Weight</td>
</tr>
<tr>
<td></td>
<td>Underweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Overweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>1 2 3 4 or more</td>
</tr>
</tbody>
</table>

Data Analysis

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BM Class</th>
<th>Year In School Collapsed Controlling for Age (n=513)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underweight and Normal Weight</td>
</tr>
<tr>
<td></td>
<td>Underweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Overweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>1 2 3 4 or more</td>
</tr>
</tbody>
</table>

Data Analysis

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BM Class</th>
<th>Year In School Collapsed Controlling for Age (n=513)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underweight and Normal Weight</td>
</tr>
<tr>
<td></td>
<td>Underweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Overweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>1 2 3 4 or more</td>
</tr>
</tbody>
</table>

Data Analysis

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BM Class</th>
<th>Year In School Collapsed Controlling for Age (n=513)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underweight and Normal Weight</td>
</tr>
<tr>
<td></td>
<td>Underweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Overweight and Obese</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>1 2 3 4 or more</td>
</tr>
</tbody>
</table>

Data Analysis

- Logistic Regression Tests
- Results during the next two presentations

Future Data Analysis

- Combines this data with data collected during Fall 2008 to Spring 2009
- Added Questions
- Sample Size of 911
### Future Data Collection
- Longitudinal study to begin in November or December of 2009
- Includes over 100 questions
- Sample size to be 1000 or higher

### You Learned...
- Questions that prompted our study
- The process of data collection
- The problems with data entry
- The process of data analysis
- Our goals for future analysis
- Unprecedented Data that will be collected
Investigating Relationships in the FLASH Pilot Study for STRIDE

Mathew’s Hands on Health Presentation

SPRING 2008 FLASH STUDY
Students’ Overweight and Obesity Rates and Undiagnosed Hypertension
Mathew R. Adams
Cal Poly Department of Statistics
Undergraduate Researcher

Introduction

- Are there differences between groups?
  - For BMI?
  - For Blood Pressure?
  - For Large Waists?

- What are the rates?
  - Good?
  - Bad?

Measured BMI Class by Sex

Year in School by Measured BMI Class
Investigating Relationships in the FLASH Pilot Study for STRIDE

Blood Pressure Status by BMI

Females
- Normal
- Prehypertension
- Hypertension
- Very high blood pressure

Males
- Normal
- Prehypertension
- Hypertension
- Very high blood pressure

Percent Blood Pressure Status by BMI

Percent Males

Conclusion

- BMI, Blood Pressure and Large Waist all have differences among certain groups of people.
- Cal Poly Students may not be as healthy as perceived.

Large Waist Status by Sex

- Females
  - Waist < 80 cm
  - Waist ≥ 80 cm

- Males
  - Waist < 94 cm
  - Waist ≥ 94 cm
Investigating Relationships in the FLASH Pilot Study for STRIDE

Andrew’s Hands on Health Presentation:

**Introduction**

- What are students’ perceptions?
- How accurate are they?
- Do perceptions change for the different BMI classes?

---

**Percent of Students Who Gave Estimates**

---

**Accuracy of Perceived Height**

---
Investigating Relationships in the FLASH Pilot Study for STRIDE

Accuracy of Perceived Height

Accuracy of Perceived Weight

Accuracy of Perceived Weight

Accuracy of Perceived BMI
Investigating Relationships in the FLASH Pilot Study for STRIDE

**Measured BMI Class by Sex**

- Female: Underweight, Overweight
- Male: Underweight, Overweight

**Self Perception of Weight Status by Measured BMI Class**

- Females: Underweight, Normal, Overweight
- Males: Underweight, Normal, Overweight

**Perceived Health Status by Measured BMI Class**

- Poor, Fair, Good, Very Good, Excellent

**Perceived Health Status by All Students**

- Poor, Fair, Good, Very Good, Excellent

- 39% Poor, 42% Fair, 9% Good, 1% Very Good, 90% Excellent
Investigating Relationships in the FLASH Pilot Study for STRIDE

**Measured BMI Class by Sex**

**Perceived Health Status by Measured BMI Class**

**Conclusion**
- Response Rates
  - High: Height, Weight, Waist Size
  - Low: BMI, Blood Pressure
- Accuracy
  - Large difference between measured BMI and perception of health and weight status
Investigating Relationships in the FLASH Pilot Study for STRIDE

Our CSU Research Competition Presentation:

STRIDE 2008-2009
FLASH PILOT STUDY
Madhura P. Adams
Katrina J. Jackson
Andy J. Zbin
Cal Poly Department of Statistics
Undergraduate Research
Advisors: Dr. Ann McDermott, Professor Heather Smith

STRIDE
• Science through Translational Research In Diet and Exercise
• Multi-disciplinary Project
• >250+ student workers representing 5 colleges from 5 majors
• Inspired the FLASH project

Introduction
• STRIDE
• Data Collection Process and Management
• Data Analysis
  • Demographics
  • Logistic Regression Analysis
  • Cardiovascular Risk Factors
  • Health Perceptions
• Future Study Plans

FLASH
• What is FLASH?
  • Large scale research project aimed towards examining the health of college students and their perceptions about personal health
• Main Theories:
  • Overweight and obesity rate for high-school seniors is 25% and it is 25% for adults.
  • Patients are given adequate tools and information to assess their own physical health status
  • Californians are healthier than the rest of the nation
Investigating Relationships in the FLASH Pilot Study for STRIDE

Data Collection
- Three samples were taken:
  - Spring 2008
  - Winter 2009
  - Spring 2009
- Sample size of n=911
- Students were asked to estimate health measurements before they were physically assessed on:
  - Weight
  - Height
  - BMI
  - Waist Circumference
  - Blood Pressure

Data Entry
- Dual Key Entered
- Benefits:
  - The two enterers act as a check for correctness of the other
- Problems:
  - Missing Values treated Differently — N/A
  - Weight of 16808 entered by both enterers — 168.8 lbs.
  - Gender Left Blank — Removed the observation

Body Mass Index (BMI)

<table>
<thead>
<tr>
<th>Level Name</th>
<th>BMI Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight and Normal Weight</td>
<td>BMI ≤ 24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>24.9 &lt; BMI ≤ 29.9</td>
</tr>
<tr>
<td>Obese</td>
<td>BMI &gt; 29.9</td>
</tr>
</tbody>
</table>

- Underweight and Normal Weight: 69%
- Overweight: 26%
- Obese: 5%

Demographics
- Gender:
  - Males: 57%, Females: 43%
- Race:
  - White 75%, Asian 10%, Hispanic 6% Black 4%, Other 8%
- Age:
  - 96% are between the ages of 17-22

Data Analysis
- Logistic Regression Models
- Run on all possible predictors of BMI
- Examples:
  - Good nights of sleep per week
  - Breakfasts per week
  - Exercise days per week
  - Alcohol and drug use
  - Year in School

Year in School by BMI

- & & & & & & &
  - Underweight & Normal Weight [BMI ≤ 24.9 kg/m^2]
  - Overweight & Obese [BMI > 24.9 kg/m^2]
**Blood Pressure Status by BMI**

- 

**Perceived Health Status**

- Level Name | BMI Range
- Underweight and Normal Weight | BMI ≤ 24.9
- Overweight | 24.9 < BMI ≤ 29.9
- Obese | BMI > 29.9

- 39% Poor
- 41% Fair
- 11% Good

**Percent of Students Who Gave Estimates**

- Underweight and Normal Weight: 69%
- Overweight: 16%
- Obese: 5%

**Perceptions**

- What are students’ perceptions?
- How accurate are they?
- Do perceptions change for the different BMI classes?
Investigating Relationships in the FLASH Pilot Study for STRIDE

**Perceived Health Status**

- Poor: 39%
- Fair: 41%
- Good: 11%
- Very Good: 91%

**Future Data Collection**

- Longitudinal study was done in the Fall of 2009
- Expanded survey includes over 100 questions
- Sample size of over 1400 respondents
- Plans to collect another sample in the Spring of 2010

**Acknowledgements**

- Faculty and Staff
  - Dr. Ann Yelmokas McDermott
  - Prof. Heather Smith
  - Dr. Aydin Nazmi
  - Dr. Kris Jankovitz
- Previous Student Analysts
  - Oliver Mead
  - Kevin Kung
Investigating Relationships in the FLASH Pilot Study for STRIDE

Our Senior Project Presentation for Statistics Faculty and Students

Overview of Presentation
- Explanation of STRIDE and FLASH
- Variables of Interest
- Initial Data Cleaning
- Tables and Analyses
- Hands on Health
- More Data Cleaning!
- Some Interesting Results
- The Future of FLASH
- What We Learned

STRIDE
- Science through Translational Research In Diet and Exercise
- Multi-disciplinary Project
- 250+ student workers representing 5 colleges from 11 majors
- Among other projects, inspired the FLASH study

FLASH
- What is FLASH?
- Large scale research project aimed towards examining the health of college students and their perceptions about personal health
- Main Theories:
  - Overweight and obesity rate for high-school seniors is 25% while it is about 70% for adults.
  - Patients are given adequate tools and information to assess their own physical health status.
  - Californians are healthier than the rest of the nation
Investigating Relationships in the FLASH Pilot Study for STRIDE

Pilot Test Design

- Three pilot studies were conducted:
  - Spring 2008
  - Winter 2009
  - Spring 2009

- Sample size of n=911

- Students were asked to estimate health measurements through a questionnaire before they were actually measured during a physical assessment.

Variables of Interest

- The 2008 pilot study survey included questions about:
  - Demographics, Perceived Measurements, Medicine, Smoking, Diet, Alcohol, Exercise and Sleep.

- The 2009 pilot studies included all of the 2008 questions but also added additional questions about:
  - Vegetarianism, Dietary Supplements, Sedentary Behaviors, Marijuana, and Binge Drinking.

Summer Work 2009

- Initial Data Cleaning for Winter/Spring 2009
  - Proc Compare in SAS (dual-key entered data)
  - Obvious outliers were addressed

- Initial Analysis on 2009 Data
  - Created a memo with frequencies and logistic regression analysis

Data Analysis

- For Example, the variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Year In School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1 2 3 4 5 Post Grad Total</td>
</tr>
<tr>
<td>High Norm</td>
<td></td>
</tr>
<tr>
<td>Low BMI</td>
<td></td>
</tr>
<tr>
<td>High BMI</td>
<td></td>
</tr>
<tr>
<td>OW1</td>
<td></td>
</tr>
<tr>
<td>OW2</td>
<td></td>
</tr>
<tr>
<td>OW3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

- For Example, the variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Level</th>
<th>Controlling for Sex = Female (n=203)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Norm</td>
<td>1 2 3 4 5 Post Grad Total</td>
</tr>
<tr>
<td>High Norm</td>
<td></td>
</tr>
<tr>
<td>Low BMI</td>
<td></td>
</tr>
<tr>
<td>High BMI</td>
<td></td>
</tr>
<tr>
<td>OW1</td>
<td></td>
</tr>
<tr>
<td>OW2</td>
<td></td>
</tr>
<tr>
<td>OW3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Class</th>
<th>Year In School Collapsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight and Normal Weight</td>
<td>1 2 3 4 or more Total</td>
</tr>
<tr>
<td>Overweight and Obese</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>
Investigating Relationships in the FLASH Pilot Study for STRIDE

Data Analysis

- For Example:
  - The variable for Year in school:

<table>
<thead>
<tr>
<th>BMI Class</th>
<th>Year in School Collapsed Controlling for Sex Example (n=388)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight and Normal Weight</td>
<td>Male</td>
</tr>
<tr>
<td>Overweight and Obese</td>
<td>Male</td>
</tr>
<tr>
<td>Total</td>
<td>Male</td>
</tr>
</tbody>
</table>

- We used Binary Logistic Regression
  - Considered Ordinal Logistic Regression

- Building our Models
  - For each possible predictor of BMI
  - Explored Interaction
  - Used Covariates: Gender and Race

Fall Work 2009

- Attempted to combine 2008 & 2009
  - Compared the demographic breakdowns
  - First analysis of new 2009 variables
- In-depth data cleaning of both 2008 & 2009 data sets
  - Hard copy of the data was found!
  - Extensive process to find incorrect entries.
  - Invited to work on a team to help modify and improve the 2010 questionnaire

Data Analysis

- CSU Research Competition
  - State-wide research competition involving all the CSU campuses.
  - Submitted a report on our FLASH research
  - Gave a 15 minute presentation to a review committee
  - Participated in a follow-up question and answer session

Hands on Health

- Updated previously submitted abstracts
- Poster Creation and Collaboration
- We each gave a 15 minute presentation:
  - Katrina: What We Have Done and Where We Are Going
  - Mat: Students’ Overweight and Obesity Rates and Undiagnosed Hypertension
  - Andy: Health Perceptions of Cal Poly Students

Winter and Spring 2010 Work

- Combined all three pilot studies and performed:
  - Logistic regression predicting BMI
  - Logistic regression predicting Blood Pressure
    - Added covariate: Year in School
- Assisted in the development of an abstract concerning the new Blood Pressure logistic regression

CSU Research Competition

- State-wide research competition involving all the CSU campuses.
- Submitted a report on our FLASH research
- Gave a 15 minute presentation to a review committee
- Participated in a follow-up question and answer session
**Investigating Relationships in the FLASH Pilot Study for STRIDE**

**Demographics**
- Gender:
  - Males: 57%, Females: 43%
- Race:
  - Asian or White 85%
  - American Indian, Black, Hispanic, and Other 9%
  - Multi-Racial 6%
- Age:
  - 96% are between the ages of 17-22

**Body Mass Index (BMI)**

<table>
<thead>
<tr>
<th>Level Name</th>
<th>BMI Range</th>
<th>Percent of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Normal</td>
<td>BMI ≤ 22.4</td>
<td>39.74%</td>
</tr>
<tr>
<td>High Normal</td>
<td>22.5 &lt; BMI ≤ 24.9</td>
<td>20.32%</td>
</tr>
<tr>
<td>Low Overweight</td>
<td>BMI ≤ 24.9</td>
<td>22.50%</td>
</tr>
<tr>
<td>High Overweight</td>
<td>24.9 &lt; BMI ≤ 28.4</td>
<td>3.18%</td>
</tr>
<tr>
<td>Obese Category 1</td>
<td>BMI ≤ 28.4</td>
<td>4.17%</td>
</tr>
<tr>
<td>Obese Category 2</td>
<td>28.5 &lt; BMI ≤ 30.9</td>
<td>3.89%</td>
</tr>
<tr>
<td>Obese Category 3</td>
<td>BMI &gt; 30.9</td>
<td>1.10%</td>
</tr>
</tbody>
</table>

**Blood Pressure Status by Gender**

- Normal (SBP ≤ 119 mmHg and DBP ≤ 79 mmHg)
- Pre-Hypertensive (SBP 120-159 mmHg or DBP 80-89 mmHg)
- Hypertensive (SBP ≥ 160 mmHg or DBP ≥ 100 mmHg)

**Blood Pressure Status by BMI**

- Normal (SBP ≤ 119 nearly and DBP ≤ 79 nearly)
- Pre-Hypertensive (SBP 120-159 nearly and DBP 80-89 nearly)
- Hypertensive (SBP ≥ 160 nearly or DBP ≥ 100 nearly)

**BMI by Year in School**

**BMI by Gender**

**BMI Categories**

- Underweight and Normal Weight
- Overweight
- Obese
Investigating Relationships in the FLASH Pilot Study for STRIDE

Perceptions
- What are students’ perceptions?
- How accurate are they?
- Do perceptions change for the different BMI classes?

Percent of Students Who Gave Estimates

Self Perception of Weight Status by Measured BMI Class

Perceived Health Status by Measured BMI Class
Investigating Relationships in the FLASH Pilot Study for STRIDE

Perceived Health Status

Perceived Health Status

Data Analysis

Future Data Collection

- Based on success of the pilot studies, the baseline for a longitudinal study was done in the Fall of 2009
- Expanded survey includes over 100 questions
- Sample size of over 1400 respondents
- Currently collecting another sample for Spring 2010
Investigating Relationships in the FLASH Pilot Study for STRIDE

Scope of Study
- Started with a senior project...
- There are plans for a manuscript on the data from the 2008 and 2009 pilot studies
- Predicting both BMI and Blood Pressure
- Increasing research opportunities
  - Dr. Roy and Dr. McLaughney joined the team to help with the 2010 analysis
  - New students hired

What We Learned
- Memo quality improvement
  - Working on different codes, files, data sets
  - Access, Excel, Word, SAS, etc.
- Communication improvement
  - Teamwork
  - Relationship with client
  - Career experience
  - See positive improvement \( \rightarrow \) STAT 465

Acknowledgements
- Faculty and Staff
  - Dr. Ann Yelmokas McDermott
  - Prof. Heather Smith
  - Dr. Aydin Nazmi
  - Dr. Kris Jankovitz
- Previous Student Analysts
  - Daniella Sakamoto
  - Oliver Mead
  - Kevin Kung

Total Hours Worked

<table>
<thead>
<tr>
<th>Hours Worked</th>
<th>Mathew Adams</th>
<th>Katrina Jackson</th>
<th>Andrew Zbin</th>
</tr>
</thead>
<tbody>
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Investigating Relationships in the FLASH Pilot Study for STRIDE

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