Original Research

Dietary Fat Lowers the Glycemic Index Response

KRYSTEN ADSUARA, BELINDA ANGULO, ASHLEY CHAMBERLIN, AMANDA VIDAL, BRITTANY WILDING

ABSTRACT

Objectives To assess the effects of dietary fat on the glycemic index (GI) response in a group of individuals by pairing 50g of carbohydrate (CHO) with different amounts of fat (15g, 30g, or 45g); and to compare the results to other data collected in a previous study that assessed only the effect of 50g of CHO on the GI response.

Design A randomized control trial study with a time series analysis over a four hour period. Individuals fasted for at least 3-4 hours prior to the study and were only allowed to consume water. They were randomly placed in one of four groups: 50g CHO control, 50g CHO+15g fat, 50g CHO+30g fat, or 50g CHO + 45g fat. Blood glucose levels were found using self-administered glucometers prior to start of study and in 30 minute intervals following carbohydrate intake until blood glucose level returned to or near their baseline level.

Subjects California State University, San Bernardino Nutrition & Food Science students (n = 37) participated as a part of an in-class lab exercise. This included one male and thirty-six females, age 20-50y. Study was conducted in a health science laboratory on the CSUSB campus on two different days, in two separate labs (Mon-19 students, Tues-18 students).

Results Results indicate that fat does indeed affect the GI response. Averages from Monday and Tuesday labs were combined and show that consuming between 15-24 grams of fat (particularly whole milk cream cheese) and 50g of CHO (white plain bagel) affects the rate at which blood glucose levels increase and decline over a 180 minute time period.

Conclusion Overall, the study supported the hypothesis that dietary fat affects the glycemic response of foods. Results show that the glycemic index response varies when carbohydrate is consumed with dietary fat during the same time period. However, further research should be conducted due to various limitations of the present study.

INTRODUCTION

Fat is believed to have an effect on the glycemic index. Previous studies such as, "The effect of the fat and carbohydrate contents in the evening meal preceding GI testing on GI," was designed to determine whether the fat and carbohydrate contents of an evening meal consumed the night prior to glycemic index testing had an effect on the GI. The result of this particular study demonstrated that consuming fat and carbohydrate the night before GI testing did not affect the results of the GI. However, the design of the CSUSB student study was different from the earlier study. Some of our participants consumed varying amounts of fat in addition to the carbohydrate and a control group consumed just the carbohydrate the morning of the GI testing. The purpose of our study was to determine the effects of different factors, such as fat, that could affect the glycemic response of carbohydrate rich foods. The objective was to evaluate the results when different amounts of fat were consumed in addition to the carbohydrate. For example, the control group was given one 3 oz. bagel that was 50g of carbohydrate. The third group consumed 30g of fat in addition to the 50g of carbohydrate. Lastly, the fourth group consumed 45g of fat in addition to the 50g of carbohydrate. The blood of each participant was tested every 30 minutes during a three-hour period to measure the level of the glycemic index. The variables that had an effect on the results were age and the presence of diabetes or hypoglycemia in the study participants.

METHODS

Study Population

The sample consisted of 37 Nutrition and Food Science students at the California State University San Bernardino campus. The gender distribution consisted of 36 females (97%) and 1 male(3%). The age range was from 20-50 years. Race and ethnicity were not accounted for in the study. Medical history, family medical history, and current medical conditions were not inquired about or disclosed in the study.

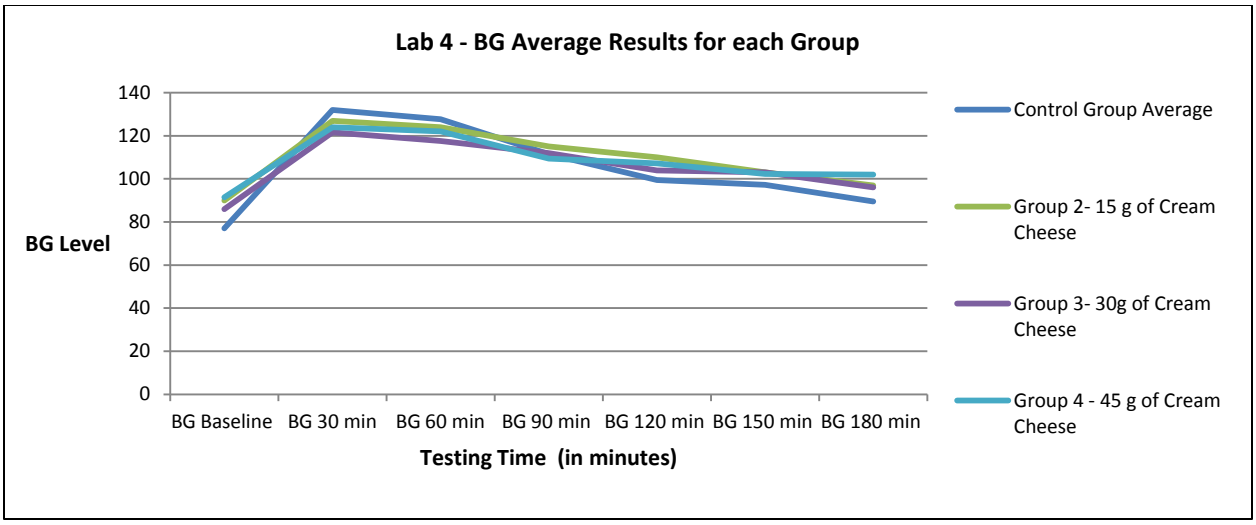


Figure 1.1 - Based on the blood glucose average, the Control Group blood glucose increased in the first hour. The remaining groups, 2, 3, and 4 demonstrated gradual growth. An hour later, the groups decreased slowly. After the last testing blood glucose, Group 4 had the highest blood glucose level. This demonstrates that consuming fat foods affects the blood glucose level.

The experiment was conducted in the health science laboratory on the CSUSB campus on two separate days, on two separate occasions. The first data was collected Monday, April 11, 2011 from 2:00 p.m. to 6:00 p.m. and included 18 subjects. The second data collection was Tuesday, April 12, 2011 from 8:00 a.m. to 12:00 p.m. and included 19 subjects. In these trials, 50 g of CHO was consumed to determine subjects' glucose tolerance and their blood sugar levels without consuming fat . The next experiments took place on Monday, April 25th and Tuesday, April 26th with the same subjects at the same times, but they were split into 4 groups and consumed varying levels of cream cheese along with the 50 g of carbohydrate.

Each subject was instructed on how to use a glucometer, lancet, and glucose strips properly to obtain their own blood glucose levels throughout the experiment. A different lancet and glucose strip was used for each reading to ensure accuracy. Rubbing alcohol and cotton balls were supplied to clean the finger each time before blood was drawn. The glucometers were labeled with numbers and each subject was to use the same glucometer that they had used in the previous study, the glucose tolerance test (GTT).

Subjects fasted three to four hours prior to the study. They were instructed not to consume any food or beverages other than water. Subjects took their first blood glucose reading to establish their baseline blood glucose, noting the time and the blood glucose level on the recording sheet.

Subjects recorded their blood glucose levels in mg/dL. The individuals were randomly assigned one of four different groups. Subjects randomly drew pieces of paper with the group numbers out of a hat to pick which group they were in. This study was not blind, everyone knew which group they were placed into. Each group consumed fifty grams (3 ounces) of carbohydrate in the form of a plain, Sara Lee bagel. Group one was the control group and consumed the bagel plain. Group two ate the bagel with one tablespoon (15 grams) of plain, whole-milk cream cheese. Group three consumed the bagel with two tablespoons (30 grams) of cream cheese. Group four had the largest amount of cream cheese, which was three tablespoons (45 grams) in addition to the bagel. Participants of the study were instructed to eat the bagel within ten minutes; recording the time they started and finished eating on the recording sheet. Eight ounces of water were consumed with the bagel,

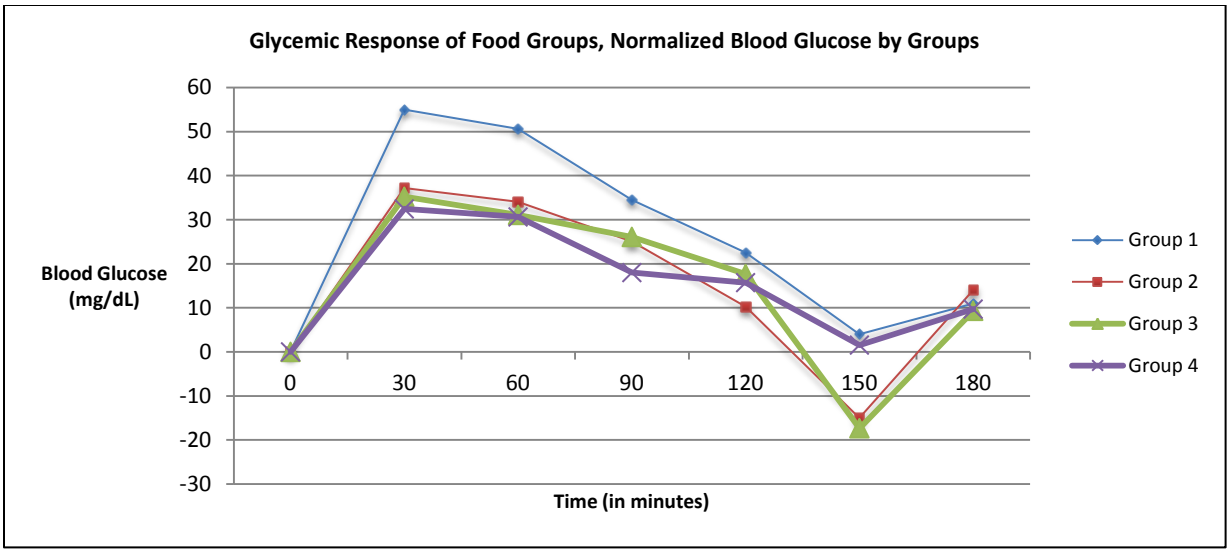


Figure 1.2 - Normalized blood glucose values depicted by groups support the study's hypothesis that dietary fat will affect the glycemic index of food. Subjects in the control group that consumed only carbohydrate had a significantly higher rise in blood glucose levels that dropped slower than the groups who consumed dietary fat.

but no other beverages throughout the study were consumed to ensure the data was not affected by beverage intake.

RESULTS

The following results are presented as averages from the Monday and Tuesday labs combined. Group one was the control group that ingested 50 grams of CHO with no fat. The baseline blood glucose reading average for the group was 77 mg/dl. After 30 minutes it was 132 mg/dl. After 60 minutes the blood glucose level had dropped down 4 dl/mg to 128 mg/dl. After 90 minutes, the average was 112 mg/dl. After 120 minutes the average was 100 mg/dl. After 150 minutes the average was 97 mg/dl. After 180 minutes the average was 90 mg/dl.

The mean normalized values for group one were as follows: Baseline blood glucose was 54 mg/dl. Blood glucose after 30 minutes was 51mg/dl. Blood glucose after 60 minutes was 35 mg/dl. Blood glucose after 90 minutes was 23 mg/dl. Blood glucose after 120 minutes was 20 mg/dl. Blood glucose after 150 minutes was 11 mg/dl.

Group two ingested 50 grams of CHO and 15 grams of cream cheese. The baseline blood glucose reading average for group two was 90mg/dl. After 30 minutes it was 127 mg/dl. After 60 minutes it was 124 mg/dl. After 90 minutes it was 115 mg/dl. After 120 minutes the average was 110 mg/dl. After 150 minutes the average was 103 mg/dl. After 180 minutes the average was 97 mg/dl.

The mean normalized values for group two were as follows: Baseline blood glucose was 37 mg/dl. Blood glucose after 30 minutes was 34 mg/dl. Blood glucose after 60 minutes was 25 mg/dl. Blood glucose after 90 minutes was 20 mg/dl. Blood glucose after 120 minutes was 13.25 mg/dl. Blood glucose after 150 minutes was 14 mg/dl.

Group three ingested 50 grams of Cho and 30 grams of cream cheese. The baseline blood glucose reading average for group three was 86 mg/dl. After 30 minutes the average was 122 mg/dl. After 60 minutes the average was 118 mg/dl. After 90 minutes the average was 113 mg/dl. After 120 minutes the average was 104 mg/dl. After 150 minutes the average remained steady at 104 mg/dl. After 180 minutes the average 96 mg/dl.

The mean normalized values for group three were as follows: Baseline blood glucose was 35 mg/dl. Blood glucose after 30 minutes was 31 mg/dl.

Blood glucose after 60 minutes was 26 mg/dl. Blood glucose after 90 minutes was 18 mg/dl. Blood glucose after 120 minutes was 13 mg/dl. Blood glucose after 150 minutes was 12 mg/dl.

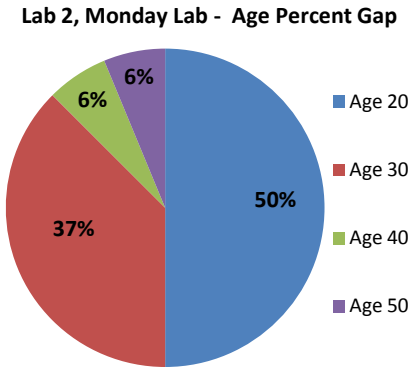
Group four ingested 50 grams of CHO and 45 grams of cream cheese. The baseline blood glucose reading average for group four was 91 mg/dl. After 30 minutes the average was 124 mg/dl. After 60 minutes the average was 122 mg/dl. After 90 minutes the average was 109 mg/dl. After 120 minutes the average was 107 mg/dl. After 150 minutes the average was 102 mg/dl. After 180 minutes the average was 102 mg/dl.

The mean normalized values for group four were as follows: Baseline blood glucose was 32 mg/dl. Blood glucose after 30 minutes was 31 mg/dl. Blood glucose after 60 minutes was 18 mg/dl. Blood glucose after 90 minutes was 16 mg/dl. Blood glucose after 120 minutes was 10 mg/dl. Blood glucose after 150 minutes was 10 mg/dl.

DISCUSSION

Fat affects the glycemic index by slowing down the release of glucose into the blood. Usually, a high GI food such as the white bagel the subjects ate, would cause a fast spike in blood glucose levels and then come back down just as rapidly as it went up. However, when the cream cheese was added, it caused blood glucose levels to steadily come down as if it were a low GI food. In this study, we observed the intake of dietary fat in varying amounts and found the response of the glycemic index to be significantly affected. According to the data, those who consumed the bagel with no cream cheese or too much cream cheese (3 tbsp) had more rapid spikes and falls in the blood glucose level over time. It seems that additives affect the GI of a carbohydrate by lowering its glycemic load.

One of the main strengths of this study is the considerable differences in the ages of students that were included in the data. A wide range in the ages of the population used only supports the data.



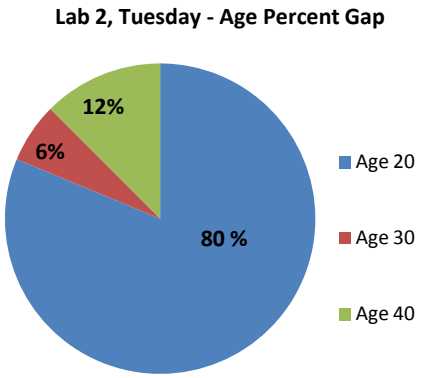


Figure 2.1 & 2.2 - The Monday lab has a relative distributed age gap percent compared to the Tuesday lab. About 80% of the Tuesday lab class is ≥20 years of age. The remaining age gap percent is around 6≥12%.

Limitations of this study include the way in which data was collected and the low amount of variables measured. Students self-administered their own blood glucose test with minimal help from the professor who presided over the study. Instructions on how to use a lancet and glucometer were brief. Results could be invalid if students did not properly read or use glucometer correctly or interpret their blood glucose level as instructed. Perhaps in future studies, trained professionals can be used to administer the blood glucose testing.

Additionally, variables such as sex, ethnicity and family medical history should be measured in a future study to determine whether or not they do play a role in an individual's glycemic response. Our population of students was limited in that there was only one male who participated

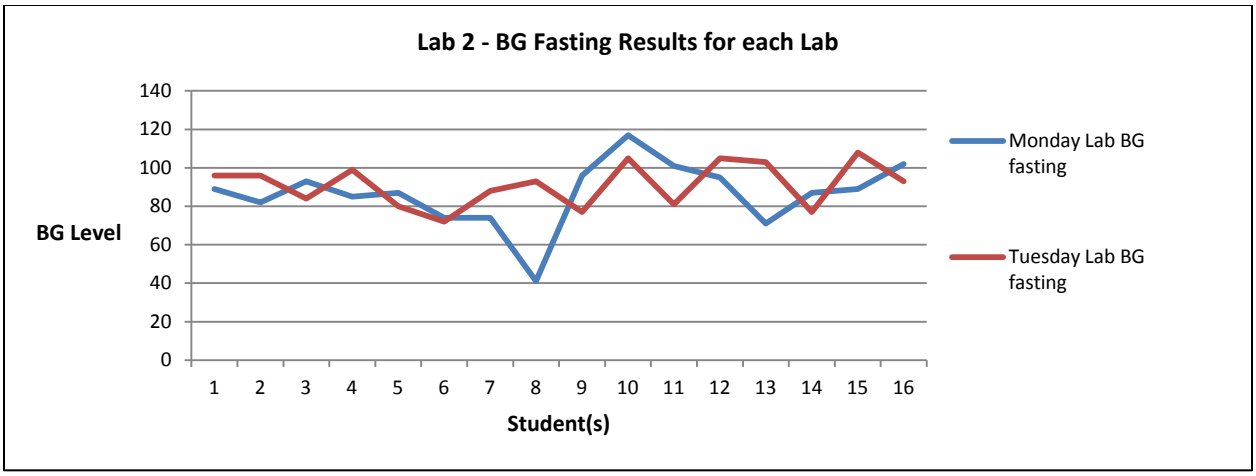


Figure 2.3 - Blood Glucose fasting level results for each lab were irregular. The students' blood glucose fasting level varies in comparison to one another. The day time the students' tested their blood glucose fasting level had an effect.

and having more male participation would have been ideal to assess that possible variable. Also, some students may have either already been diabetic or hypoglycemic prior to the study so that should have been measured as well.

CONCLUSION

The control group that consumed the bagel without any fat showed a higher increase in blood glucose levels than the groups that consumed fat with the bagel. After 30 minutes, the control group's blood sugar was an average of 55 mg/dL higher than their baseline value, whereas the other groups averaged between 30 and 40 mg/dL higher than baseline values at the same period in time. From the results of the study, we conclude that fat does indeed affect the glycemic index of foods. Consuming 15-24 grams of cream cheese with 50 grams carbohydrate affects the rate and the extent to which blood glucose levels increase and decline over a 180 minute time period.

There are a considerable amount of limitations in this study that hinders the validity and strength of the results. As previously discussed, many variables were not taken into account during the study and the training for reading blood glucose levels was brief and not extensive. Other limitations included the budget restraints of the study. Because we were on a limited budget, we used glucometer readings to gather our data. This method is not as accurate as lab readings accuracy of the results. Another limitation of this study was the small sample size and the population the sample was taken from. There were only 37 subjects which is hardly enough to draw any conclusions from. When split into four different groups, it made the sample for each of the groups even smaller and could have had an effect on the results. The sample consisted of students in the Nutrition and Food Science major at CSUSB, and it is possible that these students lead a healthier lifestyle than the average person. Since these students have knowledge on the importance of eating a balanced diet and exercise, they may be more likely to put their health as a priority. This may alter the way that the fat and carbohydrates affected the glycemic response.

The rate and extent to which blood glucose increases after eating can be altered by physical activity prior to the study. This is because glycogen levels may be depleted after exercise. The subjects' physical activity was not taken into account in this study and that may have led to varied outcomes.

One more factor that may have altered the results of the study is the fact that subjects were instructed not to consume food or drinks (besides water) 3-4 hours prior to the study. Students were told not to participate in the study if they had already eaten less than 3-4 hours, but some subjects might have felt guilty that

would have been. Also, the amount of glucose strips were limited because of the limited budget, so readings were only done once unless the reading was way off or did not work. Checking blood sugar multiple times at each time would have ensured the

they had eaten or forgot they ate and participated in the study anyway. This could also change the results because their blood glucose level would most likely be higher at baseline than if they were fasted.

Future studies should be conducted to analyze if the amount of fat consumed is inversely proportional to lower blood sugar levels. The research should question whether the greater amount of fat consumed yields lower blood glucose responses. Although our study attempts to answer this question, more research is needed on this topic. It would be interesting to conduct a study in which all of the subjects complete the glycemic response of food experiment for each of the four groups. If time and money permitted, this would be a more accurate way to test the effect of fat on the glycemic index. Also, because of the impact of fat on the glycemic index it should be researched whether or not the GI is an effective tool for individuals to utilize. The GI has become a more popular way for consumers to make food choices, but most people do not eat foods entirely on their own and the GI does not take into account the impact of other foods eaten. Our study shows significant results in the differences of glucose response when fat is consumed. However, more research needs to be conducted in this area.

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