The Effect of Physical Activity on "Real Meal" Postprandial Blood Glucose

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Abstract

The aim of this investigation was to assess the effects of physical activity on postprandial blood glucose levels under two different glycemic index meal conditions. Postprandial blood glucose levels are an important indicator of metabolic health. While exercise is known to play a role in glycemic control, glycemic index of a meal is a variable not yet explored. Subjects (*n* = 7) participated in two tests per high and low GI meal condition: a control trial and an exercise trial following the standard OGTT protocol timing. Each physical activity bout was thirty minutes in length of walking on a treadmill at the subject's chosen intensity. The average postprandial blood glucose at each time point was significantly different between the control and exercise trials under both the high and low GI conditions respectively (Two-factor ANOVA w/replication, $p < 0.05$). The data suggests that physical activity can impact postprandial blood glucose control after consumption of a "real meal" with a varied glycemic index during the intervention period.

Background Information

Metabolic conditions such as diabetes have seen a dramatic increase in prevalence worldwide. Diabetes mellitus occurs when β-cells of the pancreas are unable to produce insulin, a hormone that triggers the translocation of GLUT-4 receptors from the intracellular space to the cell membrane to allow glucose to enter the cell. Exercise is known to be an insulin-independent factor for triggering this translocation, although the effect of mode, intensity, etc. are currently under investigation. Current research does not account for complete meals that encompass all macronutrients. Thus, our research sought to investigate the effect of exercise on post-prandial blood glucose levels after consumption of meals with varying glycemic indexes. The glycemic index is a relative scale used to rank the CHO content in foods based on how they affect blood glucose.

Subjects

Subjects included seven College of Idaho undergraduate students ages 19 to 22. Participants had to have no known metabolic conditions, be of a normal BMI, and in general good health to qualify for this study. All participants signed a standardized consent form, were made aware of any possible risks associated, and were given contact information for the faculty advisor and Dean of Faculty.

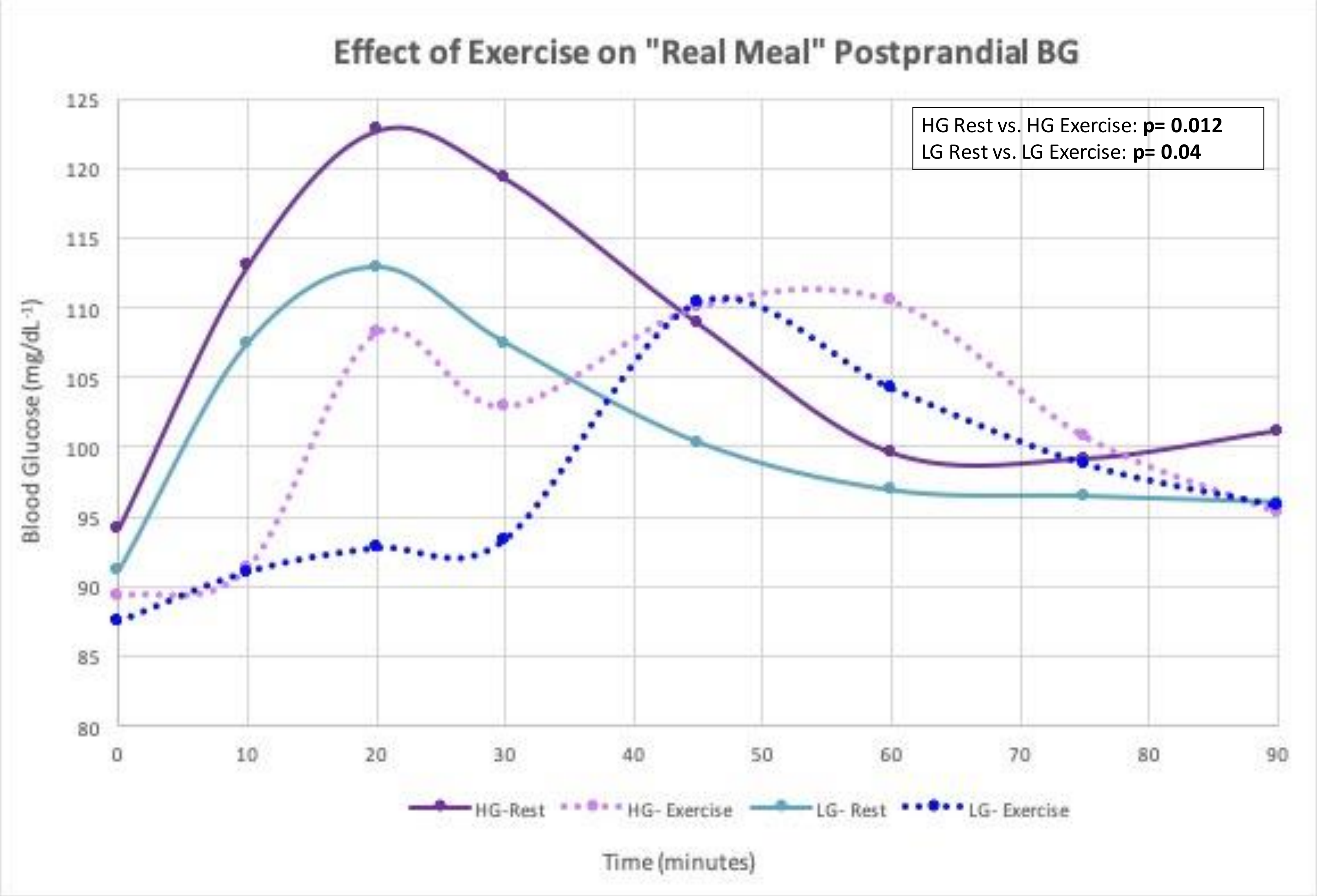

Fig. 1. Figure 1 represents the average blood glucose as a function of time across all four conditions. The intervention was implemented during the first thirty minutes of the exercise conditions. There was a significant difference between both exercise conditions & their respective controls. Error bars omitted for clarity ($p < 0.05$, *n*=7).

Table 1. Composition of high glycemic and low glycemic meals, along with their amounts in grams, respective caloric values, and their glycemic index ranking relative to glucose.

Meal Condition	Total kcal	Fat cal	Pro Cal	CHO cal	GI of Meal
Breakfast A (LGM)	452.7	99.9	81.6	271.2	38
	% macronutrients	22%	18%	60%	
Breakfast B (HGM)	452.7	98.3	82.4	274.1	68
	% macronutrients	22%	18%	60%	

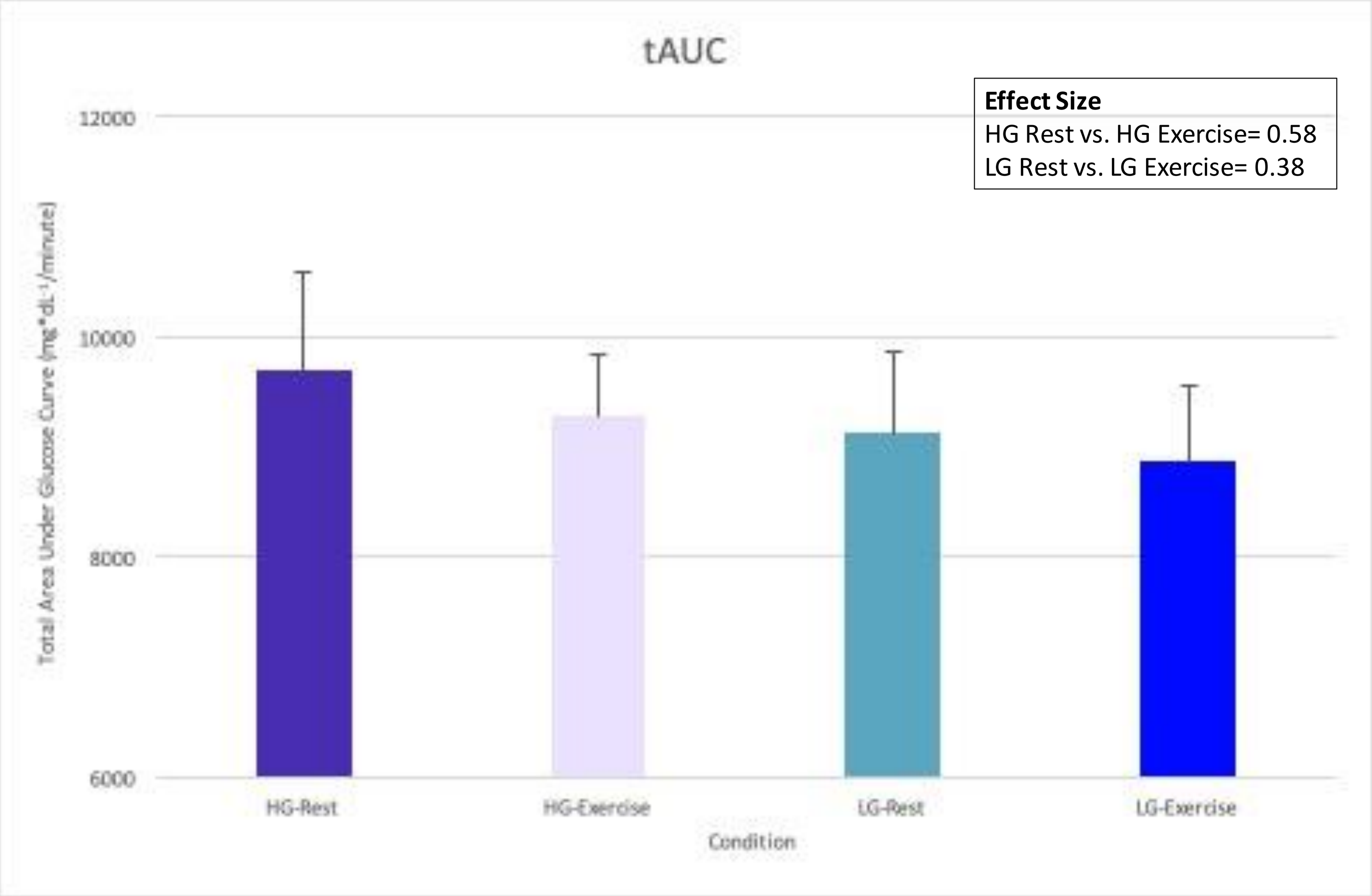

Fig. 2. A figure representing the area under the curve for each condition as an estimation of the total rise in glucose occuring during an OGTT. Cohen Effect Size was also calculated (*n*=7).

Methods

Subjects (n = 7) participated in two tests per high and low GI meal condition: a control trial and an exercise trial, both of which followed standard OGTT protocol timing. Each exercise bout was thirty minutes in length and consisted of the subject walking on a treadmill at an intensity of their choosing. Intensity was kept consistent between trials for each subject. Intensity was monitored via a Polar heart rate monitor during the exercise intervention. Post-exercise intervention, the subject was seated for the remainder of the test. The high GI meal consisted of white bread, Frosted Flakes™, margarine, & skim milk. The low GI meal consisted of All-Bran cereal & whole milk. The caloric and macronutrient content of each meal is presented in Table 1. Excel was the chosen platform for data analysis. Two-factor ANOVAs with replication and a significance level of $p \leq 0.05$ were used to assess the data and compare the control conditions, i.e. the "rest" conditions, with their exercise counterparts. Total area under the curve (tAUC) was calculated along with the Cohen d effect size to help determine magnitude of change.

Results

After conducting a two-way ANOVA with replication, we found that postprandial blood glucose was significantly different between the control and exercise trials under both the high and low GI conditions (p=0.012; p=0.04). There was a significant effect of time, which is to be expected with the OGTT protocol used. A significance level of $p \leq 0.05$ was used. Total areas under the curve (tAUC) were calculated, along with their Cohen effect sizes, with those results being summarized in Figure 2. A moderate effect ($d > 0.5$) was seen between the HG conditions, while a small effect was seen between the LG conditions.

Discussion

Considering the evidence, we move to reject our null hypothesis that there is no significant difference between the high & low GI exercise trials and their respective controls. Limitations included a small sample size and general variability between individuals. Further research is recommended to gain a better understanding of exercise's blood glucose control mechanisms within practical scenarios.

References

Solomon, T., Eves, F., Laye, M. Targeting postprandial hyperglycemia with physical activity may reduce cardiovascular disease risk. But what should we do, and when is the right time to move? *Frontiers in Cardiovascular Medicine. 5,* 99