No Dose-Response Relationship in the Effects of Commonly Consumed Sugars on Risk Factors for Diabetes Across a Range of Typical Human Consumption Levels

Joshua Lowndes, Zhiping Yu, James Rippe
Rippe Lifestyle Institute, Celebration, FL

Introduction

- The role of dietary carbohydrates, both in terms of their amount and source, in the development of obesity and associated metabolic disruptions continues to be a much investigated area.
- Of particular interest has been the role of fructose in the development of insulin resistance.
- The implication of such an effect of fructose would be considerable because of its almost ubiquitous presence in the sugars humans typically consume.
- However, the applicability to humans is questionable because of the models that have demonstrated such an effect use very high doses of fructose in isolation from other sugars or macronutrients, something that is very atypical to humans.
- Therefore the effects of fructose as it is commonly consumed, as sucrose or high fructose corn syrup (HFCS), and in amounts typically consumed is unclear.

Methods

•This ten week study included three hundred and fife five weight-stable individuals (no change in weight >3% for 3 months) who were either normal weight or overweight, normotensive, normoglycemic and with no other overt health problems.

•Individuals were required to consume sugar-sweetened low-fat milk every day for ten weeks as part of their usual diet.

•The amount of milk consumed was set so that the added sugar in the milk represented the 25th, 50th or 95th percentile for sugar consumption in the untied states. As such, participants were randomly assigned to one of the following 6 groups:

- •9% of calories required for weight maintenance from added sucrose or HFCS
- •18 % of calories required for weight maintenance from added sucrose or HFCS
- •30% of calories required for weight maintenance from added sucrose or HFCS

•Energy intake required for weight maintenance was estimated from the Mifflin St Joer prediction including an individualized activity factor based on responses to a physical activity questionnaire.

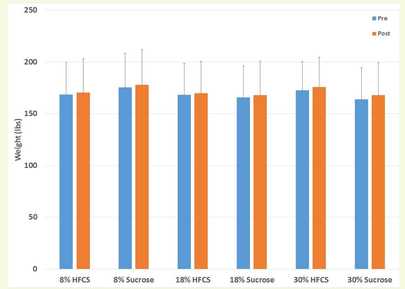
•Other than milk consumption participants followed no structured dietary program. They were counseled on how to account for the calories in the sweetened milk, but were told to continue to eat to the same level of fullness as prior to enrollment.

•Participants underwent a standard 2 hour Oral Glucose Tolerance Test from which several measures of glucose tolerance and insulin resistance were derived.

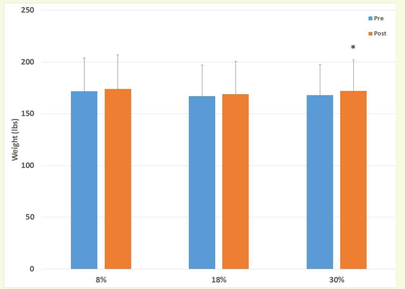
- •Fasting samples of glucose and insulin were used to calculate insulin resistance using the Homeostasis model assessment (HOMA-IR) method
- •Area under the curve (AUC) for glucose and insulin was calculated using the trapezoidal method
- •Hepatic insulin resistance was calculated as $AUC_{30}g * AUC_{30}I$
- •Whole body insulin sensitivity was also calculated using the Matsuda Insulin Sensitivity Index, calculated as $\frac{10000}{\sqrt{g_0 \times i_0 \times \frac{(g_0 \cdot 15 + g_{30} \cdot 30 + g_{60} \cdot 30 + g_{90} \cdot 30 + g_{120} \cdot 15)}{120} \times \frac{(i_0 \cdot 15 + i_{30} \cdot 30 + i_{60} \cdot 30 + i_{90} \cdot 30 + i_{120} \cdot 15)}{120}}}$

•Subjects and research staff were blinded to which sugar was consumed.

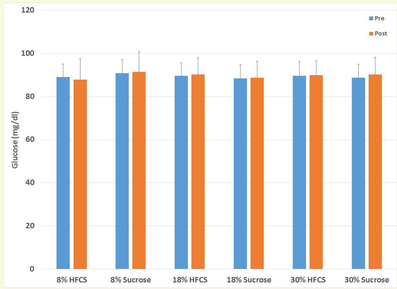
Results



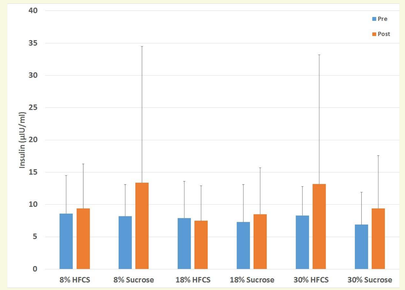
Time p<0.001
Time X Sugar Level interaction p<0.05



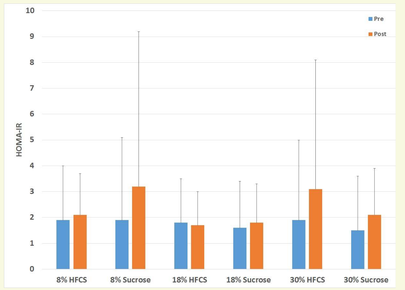
* Change greater than 8% and 18%, p<0.05



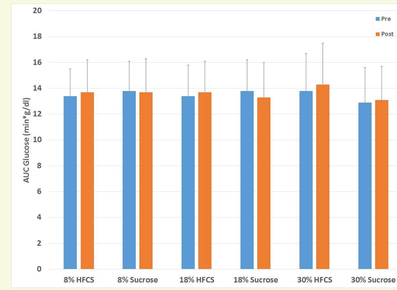
Time p>0.05
Time X group interaction p>0.05



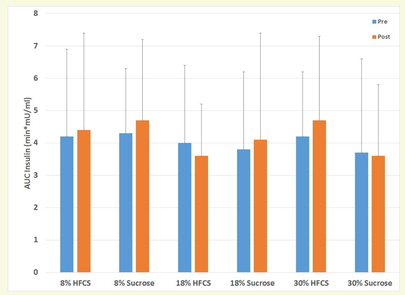
Time p<0.01
Time X group interaction p>0.05



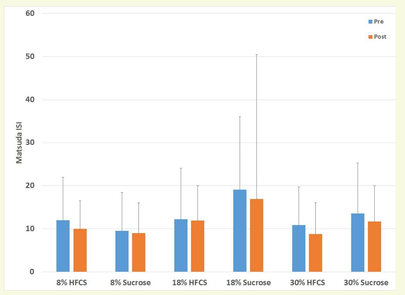
Time p<0.05
Time X group interaction p>0.05



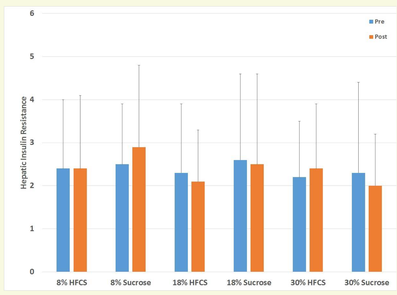
Time p>0.05
Time X group interaction p>0.05



Time p>0.05
Time X group interaction p>0.05



Time p<0.05
Time X group interaction p>0.05



Time p>0.05
Time X group interaction p>0.05

Discussion & Conclusion

- These data suggest that the impact of consuming sugar sweetened milk on the defining characteristics of type II diabetes of glucose tolerance and insulin resistance do not vary between the 25th and 95th percentile for sugar consumption
- Furthermore, at this level of consumption, the identity of the added sugar is not important

Support for this study provided by a grant from the Corn Refiners Association