Impact of Fructose and Fructose Containing Sugars on Indices of Cardiometabolic Health When Consumed at Typical Levels

Joshua Lowndes, Stephanie Sinnett, Kory Grench, Richard Jordan, James Rippe
Rippe Lifestyle Institute, Celebration, FL

RLI
Rippe Lifestyle Institute

Introduction

- The American Heart Association recommends that women and men should not consume more than 100 or 150 kcal/day, respectively, from added sugars.
- The potential of high doses of fructose to cause cardiometabolic disorders is well established.
- However, pure fructose is rarely consumed and it is unclear whether the same risks apply to the common sources of fructose in the diet – High Fructose Corn Syrup (HFCS) and Sucrose.
- The purpose of this study was two compare the effect on components of cardiometabolic health of fructose compared to other fructose containing sugars and glucose control group when consumed at levels typical of the US population.

Methods

- The study included 268 weight-stable individuals (no change in weight >3% for 3 months) who were either normal weight or over weight 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 added sugar in the milk represented the 50th percentile for sugar consumption in the United States:
    - Fructose - added fructose providing 9% of calories required for weight maintenance
    - Glucose - added glucose providing 9% of calories required for weight maintenance
    - HFCS - added HFCS providing 18% of calories required for weight maintenance
    - Sucrose - added sucrose providing 18% of calories required for weight maintenance.
- 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.
- Three-day food diaries and NDSR were used to evaluate dietary intake at baseline and after ten-weeks.
- Subjects and research staff were blinded to which sugar was consumed.

Results

Table 1. Metabolic Syndrome Components

		Entire Cohort	Time p	HFCS	Fructose	Glucose	Sucrose	Time X Group p
Waist Circumference (cm	Pre	80.88 ± 9.45		80.51 ± 9.29	82.06 ± 10.43	79.72 ±8.47	81.45 ± 9.73	
	Post	81.45 ± 9.46	<0.001	81.31 ± 8.89	82.61 ± 10.97	79.84 ± 8.47	82.38 ± 9.43	0.151
Systolic Blood Pressure (mmHg)	Pre	109.16 ± 10.17		108.61 ± 9.70	107.71 ± 10.51	109.17 ± 10.09	111.14 ±10.28	
	Post	106.13 ± 10.39	<0.001	107.57 ± 11.29	105.49 ± 9.97	104.60 ± 9.78	107.25 ± 10.55	0.081
Diastolic Blood Pressure (mmHg)	Pre	69.78 ± 8.71		69.48 ± 9.71	69.68 ± 8.83	68.96 ± 8.34	71.14 ± 8.02	
	Post	68.05 ± 9.68	0.003	68.90 ± 10.78	67.82 ± 8.91	66.12 ± 9.35	69.81 ± 9.48	0.510
HDL (mg/dl)	Pre	51.51 ± 12.77		53.52 ± 13.07	51.45 ± 12.97	52.92 ± 13.06	52.11 ± 12.11	
	Post	52.36 ± 12.93	0.760	53.08 ± 13.91	51.42 ± 12.75	52.33 ± 12.91	52.67 ± 12.40	0.766
Triglycerides (mg/dl)	Pre	101.56 ± 56.47		98.20 ± 52.46	104.29 ± 68.24	100.28 ± 56.19	103.54 ± 47.56	
	Post	111.70 ± 79.14	0.005	129.03 ± 120.49†	106.86 ± 66.13	99.86 ± 57.21	114.21 ± 60.43	0.021
Glucose (mg/dl)	Pre	90.00 ± 6.50		89.43 ± 6.54	90.48 ± 7.07	90.66 ± 6.18	89.27 ± 6.27	
	Post	90.66 ± 7.89	0.187	88.41 ± 8.24	91.65 ± 9.25	91.03 ± 6.69	91.38 ± 7.09	0.170

Table 2 Weight and Body Fat

		Entire Cohort	Time p	HFCS	Fructose	Glucose	Sucrose	Time X Group p
Weight (lbs)	Pre	162.23 ± 27.28		162.09 ± 26.12	166.61 ± 30.90	159.13 ± 24.88	161.66 ± 27.26	0.118
	Post	164.15 ± 28.14	<0.001	164.05 ± 27.28	168.15 ± 32.52	160.44 ± 24.81	164.66 ± 27.99	
Body Fat %	Pre	34.24 ± 8.99		33.42 ± 9.39	33.90 ± 8.91	33.42 ± 9.36	36.13 ± 8.42	
	Post	34.79 ± 8.74	<0.001	34.16 ± 8.98	34.21 ± 8.91	33.76 ± 9.21	36.89 ± 7.86	0.445
Abdominal Fat %	Pre	36.31 ± 11.58		34.71 ± 12.11	36.35 ± 11.63	35.19 ± 12.60	38.70 ± 10.03	
	Post	36.84 ± 11.20	0.011	35.47 ± 11.40	36.52 ± 11.80	35.43 ± 12.44	39.68 ± 8.88	0.423

Table 3. Related Measures

		Entire Cohort	Time p	HFCS	Fructose	Glucose	Sucrose	Time X Group p
Total Cholesterol (mg/dl)	Pre	177.39 ± 39.44		175.33 ± 41.67	181.26 ± 40.84	176.28 ± 39.35	176.75 ± 36.43	
	Post	180.10 ± 39.98	0.038	179.98 ± 41.96	180.72 ± 35.53	176.16 ± 42.30	184.33 ± 39.96	0.116
LDL (mg/dl)	Pre	104.27 ± 34.20		100.52 ± 35.18	109.20 ± 34.74	103.37 ± 34.31	103.92 ± 32.80	
	Post	105.41 ± 34.58	0.341	101.13 ± 33.37	107.97 ± 30.86	103.84 ± 36.68	108.78 ± 36.85	0.361
Apolipoprotein B (mg/dl)	Pre	86.53 ± 25.79		86.02 ± 26.29	89.09 ± 27.43	83.02 ± 26.18	88.60 ± 23.06	
	Post	90.78 ± 25.62	<0.001	89.31 ± 25.63	92.35 ± 23.29	87.47 ± 25.48	94.59 ± 27.93	0.779
Insulin (μIU/ml)	Pre	8.55 ± 6.10		7.99 ± 5.71	9.43 ± 6.13	8.63 ± 7.12	8.07 ± 5.06	
	Post	11.20 ± 39.32	0.246	8.64 ± 5.77	18.65 ± 78.72	9.07 ± 6.18	8.56 ± 5.56	0.455
HOMA Insulin Resistance	Pre	1.60 ± 1.35		1.39 ± 0.98	1.65 ± 1.05	1.76 ± 2.14	1.58 ± 0.91	
	Post	1.74 ± 1.29	0.216	1.57 ± 1.04	1.78 ± 1.42	2.04 ± 1.56	1.58 ± 1.04	0.870
2 Hour AUC Glucose AUC (min*g/dl)	Pre	13.28 ± 2.53		12.91 ± 2.17	13.43 ± 2.46	12.98 ± 2.62	13.71 ± 2.81	
	Post	13.16 ± 2.56	0.572	12.91 ± 2.67	13.55 ± 2.44	12.95 ± 2.64	13.16 ± 2.56	0.640
2 Hour AUC Insulin (min*mU/ml)	Pre	2.52 ± 1.32		2.43 ± 1.40	2.84 ± 1.46	2.47 ± 1.32	2.32 ± 1.06	
	Post	2.54 ± 1.57	0.775	2.54 ± 1.62	2.82 ± 1.77	2.33 ± 1.61	2.46 ± 1.22	0.647

† Change Greater than Glucose.

Discussion & Conclusion

- These data suggest that when consumed as part of normal diet at typical levels the effects of commonly consumed sugars on cardiometabolic health is small and primarily related to body composition, even when consumption is significantly higher than recommended by the AHA.
- While differential effects were observed for triglycerides, the often cited negative effects of fructose or fructose containing sugars compared to glucose was not evident for any other measure.