

Presented by: Caitlin Mondelli
& Candace Richards

The effects of 4 hypocaloric diets containing different levels of sucrose or high fructose corn syrup on weight loss and related parameters

Joshua Lowndes, Diana Kawiecki,
Sabrina pardo, Von Nguyen,
Kathleen J Leanson, Zhiping Yu,
and James M Rippe

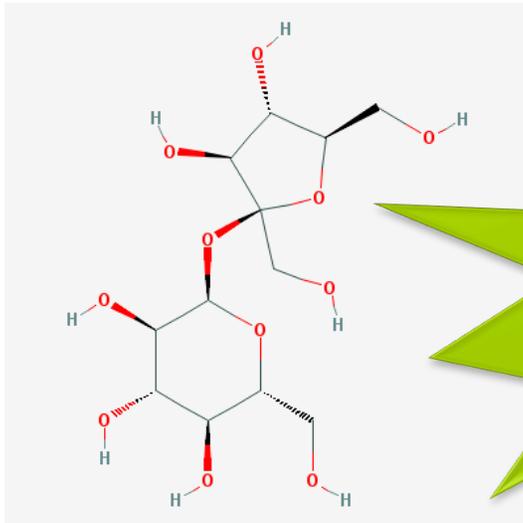


Outline of Discussion

- Background
 - Definitions of sucrose, HFCS, added sugars
 - Importance of added sugars
 - Justification for research
- Purpose/objective
- Methods and procedures
 - Study design
 - Recruitment strategies
 - Treatment descriptions
 - Statistics used
- Results
 - Demographics (Table 1)
 - Dietary intake (Table 2)
 - Body mass and adiposity (Table 3 and Figure 1)
 - Cholesterol and lipids (Table 4)
- Discussion/Conclusion
- Application to profession

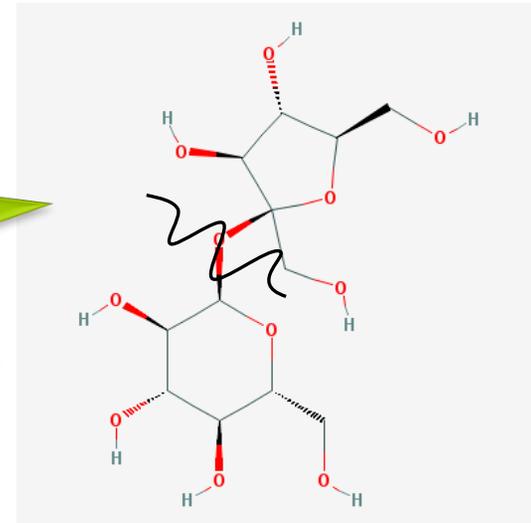
Sucrose

- Sucrose is a disaccharide of glucose and fructose
- “Table Sugar”



High Fructose Corn Syrup

- High fructose corn syrup is composed of free glucose and fructose
- “Corn sugar”



Both are used
as “added
sugars”

More on HFCS

Form of HFCS	Composition	Common uses
HFCS - 55	55% fructose 45% glucose	Carbonated soft drinks
HFCS - 42	42% fructose 58% glucose	Baked goods and other products

Added Sugars

- Simple carbohydrate
 - Fruits
 - Vegetables
 - Dairy
- Often added during processing of foods
 - Flavor, preservative, texture, color, bulking agent, etc
- Can contribute to poor nutrition, weight gain, increased triglycerides, tooth decay
- 90% of Americans consuming more added sugars than what the American Heart Association recommends
 - <150 calories a day for men
 - <100 calories a day for women

Previous research on added sugars

- Many studies have compared pure fructose and pure glucose consumption
 - Fructose vs. glucose = differences in responses of insulin, leptin, and ghrelin
 - Increase in appetite = increase in weight gain
 - Neither are commonly consumed in human diet
- Some epidemiologic studies
 - Can only establish associations, not cause and effect
- Very little prospective data looking at the effects of either sucrose or HFCS on body weight and body composition

- Investigators argue that there is a linkage between added sugars and weight gain/obesity
- Data from U.S. Agriculture's Economic Research Service show that increase in sugar intake in last 40 yrs is only a small percentage of overall increase in energy intake
 - ~11% of the calorie increase can be attributed to sugar

Purpose of current study

- “Explore whether two different amounts of either sucrose or HFCS, when consumed at current population levels (10% or 20% of calories as fructose, representing the 25th and 50th percentile population fructose intake levels, respectively) have any adverse impact on the ability to lose weight or change body composition when consumed as part of mixed nutrient, hypocaloric diets.”

Methods and Procedures

- 12 week, randomized, prospective, double blind trial
- Involving 247 overweight/obese subjects
- Aged 25-60
- Location: two sites in Orlando, FL

Recruitment

- Exclusions
 - Weight loss program, prescription meds, or supplements for weight loss
 - >5lb. Weight loss or Major surgery past 3 months
 - Orthopedic limitations, Heart problems
 - Eating Disorder/G.I. Disorder
 - Dietary restrictions/allergies
 - Use of cigarettes/tobacco
 - >14 alcoholic beverages/week

Recruitment

- Inclusion Strategy:
 - Between ages 25-60 years of age
 - Body Mass Index (BMI) of 27.0-35.0



Group Assignments

Group #1 (HFCS 10%)

- Sweetener at 10% total calories; 25th percentile fructose intake; exercise included

Group #2 (HFCS 20%)

- Sweetener at 20% total calories; 50th percentile fructose intake; exercise included

Group #3 (Suc 10%)

- Sweetener at 10% total calories; 25th percentile fructose intake; exercise included

Group #4 (Suc 20%)

- Sweetener at 20% total calories; 50th percentile fructose intake; exercise included

Group #5 (EO)

- Control group; eucaloric diet; exercise included

Methods

- All groups included fitness walking program
- Sweeteners were supplied in 1% low-fat milk
- Hypocaloric diets for groups 1-4 based on individual calorie levels (Mifflin-St Jeor)
- Meal Plan (AND Exchange List):
 - 50-55% CHO
 - 15-20% PRO
 - 25-30% Fat

Exercise Prescription

- Assigned to all 5 groups
- Walking: preferred type
- Other forms were encouraged
- Progression over 12 week study:
 - 1-3 weeks: 15mins/3x per week to 45mins/3x per week
 - Remained at 45mins/3x per week until week 12
- 5min warm up and 10min cool down included

Counseling

- Counseled by RDs (Group #'s 1-4):
 - Diet initiation
 - Menu suggestions and recipes provided
 - Every week during 12-week study
 - Dietary checklists and physical activity reviewed
 - Discussed challenges
- Control Group (#5):
 - Met with exercise physiologists weekly
 - Monitored exercise status
- All 5 groups completed 3-day food record at weeks 6 and 12

Statistics

- 2-way Analysis of Variance with repeated measures
- Significant time X group assignment interactions probed by assessing within-subject change in each group independently.
- Changes over 12 weeks calculated and assessed by one was ANOVA
- Alpha value set at 0.05

Demographics

- 247 enrolled and 162 completed the 12-week intervention
 - Female = 127
 - Male = 35
- Dropouts were, on average, younger in age
 - 38.3 ± 10.8 vs 42.9 ± 10.3
- Attrition (n = 85)
 - Lack of compliance (n = 38)
 - Time commitment (n = 21)
 - Intolerance to milk/unwillingness to consume (n = 15)
 - Moved out of town (n = 4)
 - Pregnancy (n = 3)
 - General dissatisfaction (n = 4)

Table 1 Baseline characteristics on participants (n = 162) who completed the intervention

	Entire population n = 162	10% HFCS n = 36	20% HFCS n = 24	10% Sucrose n = 29	20% Sucrose n = 33	EO n = 40
Age (years)	42.8 ± 10.2	40.7 ± 10.3	41.7 ± 11.3	41.7 ± 11.2	42.9 ± 11.2	41.4 ± 10.2
Body Mass (kg)	87.2 ± 12.5	88.9 ± 12.3	89.4 ± 12.8	87.7 ± 14.2	89.1 ± 15.1	86.5 ± 12.7
BMI	31.9 ± 3.3	32.0 ± 3.4	32.2 ± 3.1	31.6 ± 3.7	32.1 ± 3.3	31.8 ± 3.1
Body Fat Percent	43.1 ± 6.5	43.2 ± 6.8	43.5 ± 6.3	44.0 ± 7.2	42.3 ± 5.8	42.4 ± 6.5
Blood Glucose (mmol/L)	4.9 ± 0.4	5.0 ± 0.4	5.0 ± 0.5	5.2 ± 0.7	5.1 ± 0.7	5.1 ± 0.6
Cholesterol (mmol/L)	4.9 ± 1.0	4.8 ± 1.1	4.9 ± 1.0	5.0 ± 1.2	5.0 ± 1.0	5.0 ± 0.8

Note: Attrition rates were not significantly different among the groups (37%, 47%, 40%, 28% and 25% respectively).

Table 2: Dietary Intake

- Table 2—Freida Pan
- 96.6% compliance to sweetened milk in all four intervention groups
- Energy intake decreased by 123 KJ per day across all 5 groups
- Dietary groups also:
 - Decreased dietary fat
 - Increased consumption of added sugars
 - Overall decrease in dietary carbohydrate consumption
- *actual sucrose and/or HFCS consumption couldn't be measured

Table 2 Dietary intake

		HFCS 10%	HFCS 20%	Suc 10%	Suc 20%	EO	All	Time X group interaction
Energy Intake (KJ)	Baseline	9245 ± 3839	7832 ± 1832	7766 ± 2479	8724 ± 2875	7992 ± 2032	8361 ± 2793	0.099
	Week 12	7171 ± 2150	6764 ± 1082	6755 ± 1953	7268 ± 1613	7496 ± 2223	7130 ± 1901***	
Fat (g)	Baseline	88.2 ± 48.5	69.4 ± 22.8	70.5 ± 26.5	84.2 ± 35.1	72.3 ± 23.0	77.6 ± 34.0	<0.001
	Week 12	50.5 ± 22.3***	46.1 ± 11.4***	49.9 ± 20.1**	49.0 ± 17.7***	69.8 ± 27.9	54.0 ± 22.9	
Carbohydrates (g)	Baseline	269.6 ± 108.8	236.7 ± 74.3	230.6 ± 76.2	249.8 ± 92.4	241.4 ± 67.6	246.9 ± 86.1	0.462
	Week 12	241.0 ± 66.6	234.6 ± 41.8	220.1 ± 62.3	250.1 ± 49.6	212.9 ± 74.4	231.4 ± 62.4	
Total Sugar (g)	Baseline	117.7 ± 63.2	98.0 ± 53.6	89.2 ± 39.8	101.7 ± 56.8	92.9 ± 42.8	100.5 ± 52.5	<0.001
	Week 12	143.9 ± 34.6**	163.2 ± 27.3***	125.2 ± 34.0***	163.3 ± 35.0***	83.8 ± 43.8	133.1 ± 47.0	
Added Sugar (g)	Baseline	81.8 ± 56.0	62.0 ± 55.1	63.6 ± 38.5	74.1 ± 50.1	61.3 ± 33.2	69.1 ± 47.2	<0.001
	Week 12	67.1 ± 22.5	95.8 ± 20.0*	59.1 ± 26.6	97.8 ± 21.1*	50.3 ± 32.8*	72.2 ± 31.7	

Different than baseline, p < 0.05 *, p < 0.01 **, p < 0.001 ***.

Body Mass and Adiposity

- *Reductions in all measures of adiposity
- Time by group interactions were significant for adiposity measures:
 - Body Mass ($p < 0.01$)
 - BMI ($p < 0.05$)
 - Waist Circumference ($p < 0.05$)
 - Body Fat % ($p < 0.05$)
- Table 3—Erika Davis

Table 3 Changes in body mass and measures of adiposity

		Baseline	Week 12	Time X group interaction p
Body Mass (kg)	HFCS 10%	89.39 ± 11.92	85.24 ± 11.48***	0.003
	HFCS 20%	87.03 ± 11.73	84.61 ± 12.60*	
	Sucrose 10%	86.55 ± 13.10	83.20 ± 12.52***	
	Sucrose 20%	87.76 ± 13.25	85.77 ± 13.26***	
	EO	86.49 ± 12.69	85.46 ± 13.36*	
BMI	HFCS 10%	31.48 ± 3.22	30.03 ± 3.30***	0.006
	HFCS 20%	32.30 ± 3.26	31.39 ± 3.65*	
	Sucrose 10%	31.33 ± 3.71	30.17 ± 3.80***	
	Sucrose 20%	31.90 ± 3.15	31.93 ± 3.44***	
	EO	32.34 ± 3.35	30.94 ± 3.52*	
Waist Circumference (cm)	HFCS 10%	91.88 ± 8.04	87.75 ± 8.21***	0.022
	HFCS 20%	90.00 ± 10.88	86.40 ± 10.42***	
	Sucrose 10%	90.75 ± 7.50	86.76 ± 7.97***	
	Sucrose 20%	92.38 ± 9.47	90.01 ± 10.00***	
	EO	93.54 ± 8.79	91.53 ± 8.59***	
Body Fat%	HFCS 10%	42.09 ± 6.98	39.65 ± 9.40**	0.017
	HFCS 20%	42.93 ± 5.58	41.82 ± 5.94*	
	Sucrose 10%	43.75 ± 7.55	42.21 ± 8.22**	
	Sucrose 20%	42.54 ± 6.27	41.20 ± 6.97***	
	EO	43.40 ± 6.55	43.02 ± 6.55	

Different than baseline, p < 0.05 *, p < 0.01 **, p < 0.001 ***.

Body Mass and Adiposity cont.

- In all cases the change from baseline to post testing was greater for HFCS 10% than for EO
- No significant differences among the four hypocaloric groups (# 1-4) from baseline to post testing.
- Figure 1—Jenna McClure

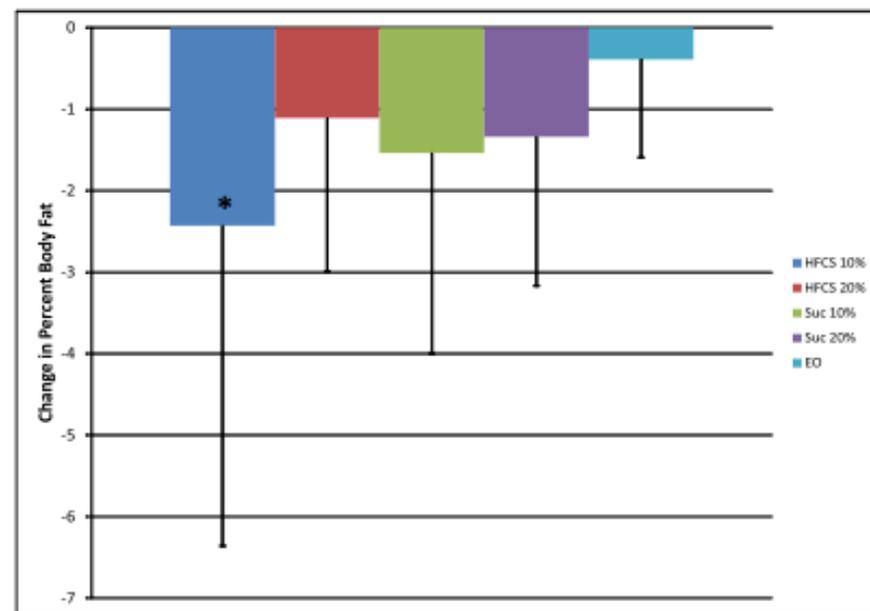
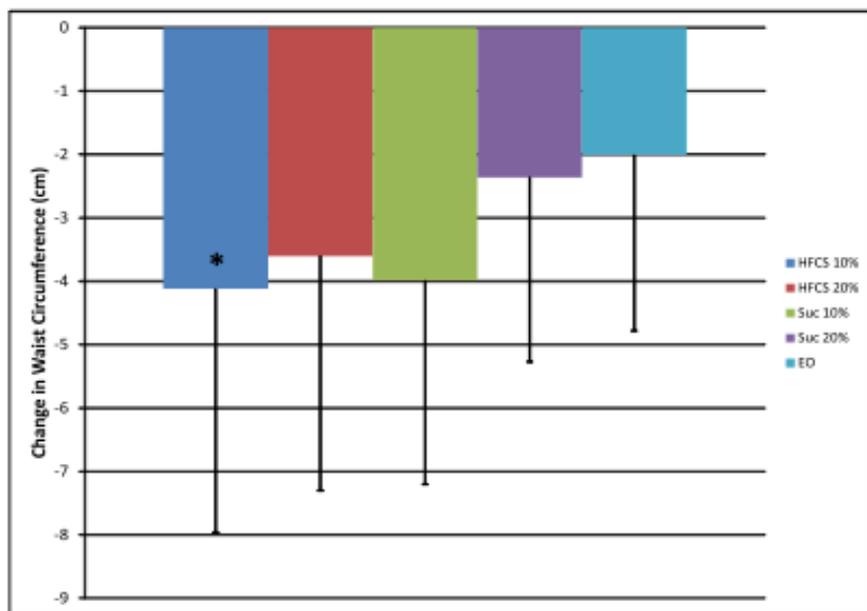
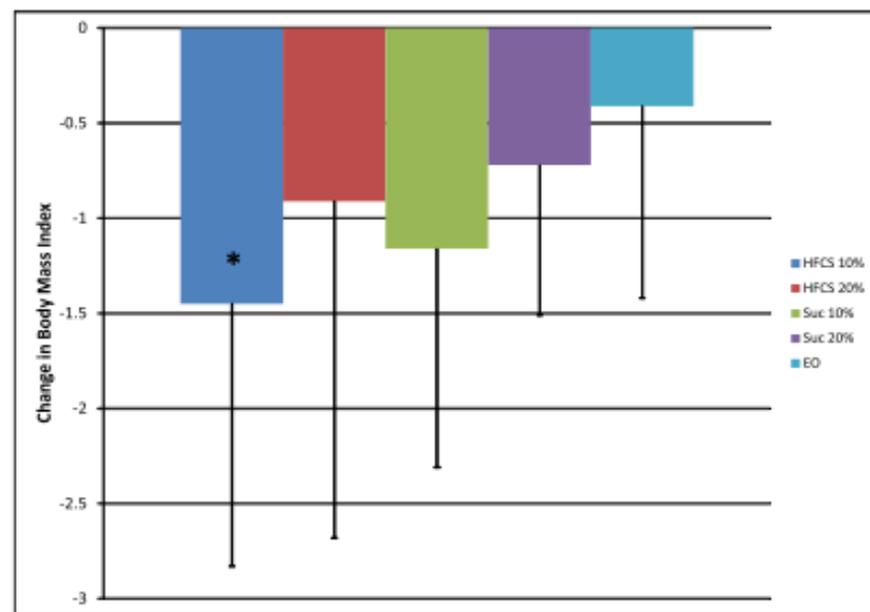
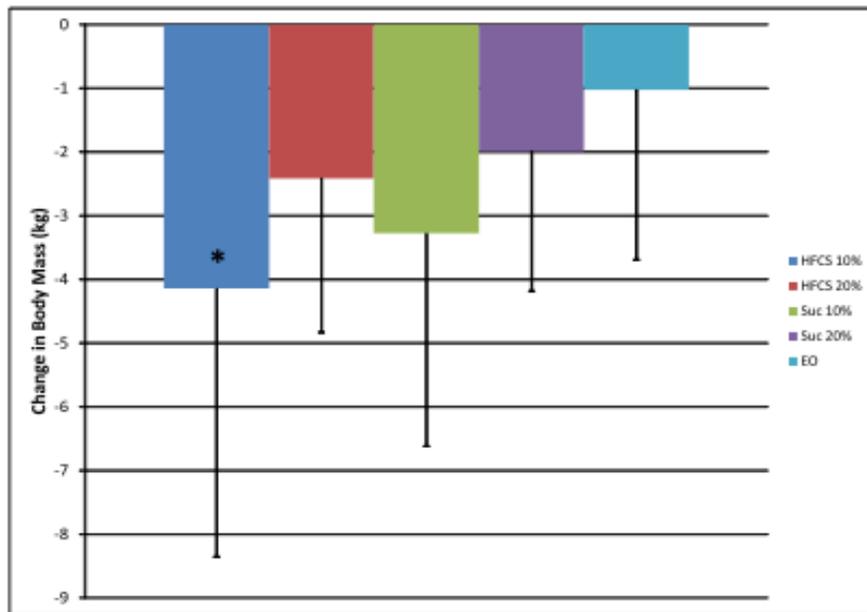


Figure 1 Changes in body mass and measures of adiposity after 12 weeks on a (500Kcal/day) hypercaloric diet containing either 10% or 20% of calories from HFCS.

Cholesterol and lipids

- Reductions in total cholesterol, triglycerides, and LDL in entire cohort ($p < 0.001$)
- No change in HDL
- Changes in measures among groups were similar (time X group interaction $p > 0.05$)
- Table 4—Michelle Li

Table 4 Changes in cholesterol and lipids

		Baseline	Week 12	Time p	Time X group interaction p
Cholesterol (mmol/L)	HFCS 10%	4.78 ± 1.14	4.44 ± 1.11		0.078
	HFCS 20%	4.95 ± 0.89	4.47 ± 0.76		
	Sucrose 10%	5.14 ± 1.18	4.81 ± 0.98		
	Sucrose 20%	5.01 ± 1.04	4.61 ± 0.98		
	EO	4.82 ± 0.08	4.77 ± 0.96		
	All	4.93 ± 1.01	4.63 ± 0.98***	<0.001	
Triglycerides (mmol/L)	HFCS 10%	1.34 ± 0.56	1.22 ± 0.55		0.806
	HFCS 20%	1.30 ± 0.71	1.07 ± 0.50		
	Sucrose 10%	1.33 ± 0.63	1.08 ± 0.34		
	Sucrose 20%	1.42 ± 0.86	1.28 ± 0.70		
	EO	1.55 ± 0.73	1.38 ± 0.67		
	All	1.40 ± 0.70	1.22 ± 0.58***	<0.001	
HDL (mmol/L)	HFCS 10%	1.30 ± 0.22	1.30 ± 0.27		0.182
	HFCS 20%	1.37 ± 0.34	1.28 ± 0.27		
	Sucrose 10%	1.41 ± 0.33	1.38 ± 0.35		
	Sucrose 20%	1.34 ± 0.35	1.29 ± 0.32		
	EO	1.25 ± 0.24	1.28 ± 0.23		
	All	1.33 ± 0.30	1.30 ± 0.28	0.090	
LDL (mmol/L)	HFCS 10%	2.87 ± 0.98	2.61 ± 0.91		0.372
	HFCS 20%	2.99 ± 0.78	2.70 ± 0.66		
	Sucrose 10%	3.12 ± 1.02	2.95 ± 0.93		
	Sucrose 20%	2.94 ± 0.94	2.68 ± 0.85		
	EO	2.87 ± 0.74	2.85 ± 0.89		
	All	2.95 ± 0.89	2.76 ± 0.86***	<0.001	

Different than baseline, p < 0.05 *, p < 0.01 **, p < 0.001 ***.

Discussion

- Major finding: typical pop. Intake levels of added sugars does not prevent weight loss and associated improvements in body composition
- Decrease in serum cholesterol levels
 - Ranging from 13 to 19 mg/dL
 - Clinically significant
- No unique connection between obesity and consumption of HFCS
- No unique connection between added sugars and metabolic parameters

Conclusion

- Equally hypocaloric diets cause similar weight changes regardless of type or amount of sugar consumed
 - Metabolic equivalency of sucrose and HFCS
- Strengths
 - Double blind, randomized, prospective study
 - relatively large sample in a normal population
- Weaknesses
 - Only 12 weeks
 - Children, adolescents, and elderly subjects excluded
 - 35% dropout rate
 - Exercise may be a confounding factor
 - 78% of participants were women

Application to Profession

- Overall restriction of sugar
 - There really is no difference between HFCS vs. sucrose in terms of both chemical composition and its effect on obesity
 - Watch “empty calories”
- Explaining to patients/clients the misunderstanding about HFCS