



2017

Fructose and its Contribution to Cardiovascular Disease and Metabolic Syndrome

Jessica Anderson
University of North Dakota

Follow this and additional works at: <https://commons.und.edu/pas-grad-posters>

 Part of the [Cardiovascular Diseases Commons](#), and the [Nutritional and Metabolic Diseases Commons](#)

Recommended Citation

Anderson, Jessica, "Fructose and its Contribution to Cardiovascular Disease and Metabolic Syndrome" (2017). *Physician Assistant Scholarly Project Posters*. 30.
<https://commons.und.edu/pas-grad-posters/30>

This Poster is brought to you for free and open access by the Department of Physician Studies at UND Scholarly Commons. It has been accepted for inclusion in Physician Assistant Scholarly Project Posters by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinebyousif@library.und.edu.

Fructose and its Contribution to Cardiovascular Disease and Metabolic Syndrome

Jessica Anderson, PA-S

Department of Physician Assistant Studies, University of North Dakota School of Medicine & Health Sciences

Grand Forks, ND 58202-9037



Abstract

- The incidence of obesity, cardiovascular disease, and combination of symptoms classified as “metabolic syndrome” that eventually leads to type 2 diabetes have risen dramatically over the past few decades. The current dietary guidelines that advised patients to avoid dietary fats were originally developed in the 1960’s. This led the way for food manufacturers to remove fats in processed foods and replace them with sugars, particularly fructose. At the time there was no clinical trial data that definitively supported these guidelines.
- The increased use of fructose as a food additive has dramatically increased the per-capita consumption of this sugar. More recent research has found that the unique structural and metabolic differences of fructose as compared to glucose lead to specific pathophysiologic changes in the body that promote obesity, hypertension, atherosclerosis, dyslipidemia and glucose intolerance. Other studies have also found that consumption of certain fats may be beneficial and protective, actually preventing some of the previously mentioned conditions.
- It is evident that fructose consumption, as compared to glucose or fat consumption, leads to a higher incidence of cardiovascular disease and metabolic syndrome in the population. New dietary guidelines, strategies, and changes to food production are necessary to combat this problem, however the reversal of rules that have been in place for decades will be difficult and take many years. Therefore, to have the most impact, patient education needs to start at the primary care level.

Introduction

- 33% of American adults are considered obese; CV disease and metabolic syndrome increasing
- Dietary guidelines focus on lowering fat intake without supportive clinical trial data
- Food processors remove fats from foods and replace them with sugars, mainly fructose, as a way to preserve taste and texture

Statement of the Problem

- Time trend data over the past 30-40 years correlate increased sugar intake with incidence of obesity and diabetes
- 75% of all processed foods contain added sugar
- Fructose is the added sugar of choice due to its low cost and availability

Research Question

Does fructose consumption, as compared to glucose or fat consumption, contribute to the incidence of cardiovascular disease and metabolic syndrome?

Literature Review

THEME 1: FRUCTOSE CONSUMPTION AND PRESENCE IN THE FOOD SUPPLY

- US consumption is 50 times higher than it was in the 1800’s
- Average adult consumption is 97 grams per day with less than 20 grams coming from fruits and vegetables
- High fructose corn syrup (HFCS) is a common sweetener used because it is inexpensive



THEME 2: DIETARY GUIDELINES FOR FAT AND SUGAR CONSUMPTION

- 1950’s: Research showed an increase in serum lipids when high fat foods were consumed; same foods also had a high sugar content
- 1960’s: Current dietary guidelines were developed but were not based on randomized clinical trial data; fat limited to <30% of calories but no limitations on sugar intake

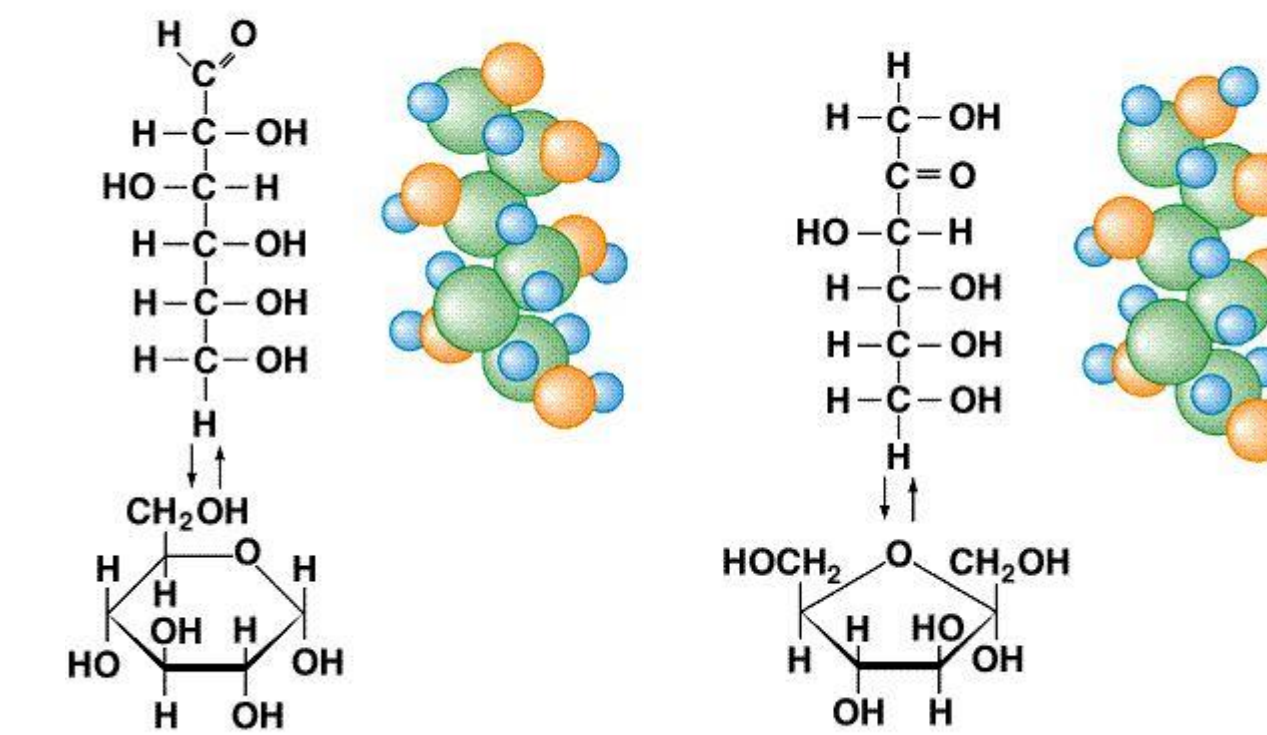
Acknowledgement

I would like to thank my family for their support and understanding as I have worked to pursue my goal of becoming a Physician Assistant. I would also like to thank my advisor, Daryl Sieg, PA-C, for his help and guidance throughout the process of completing this Scholarly Project.

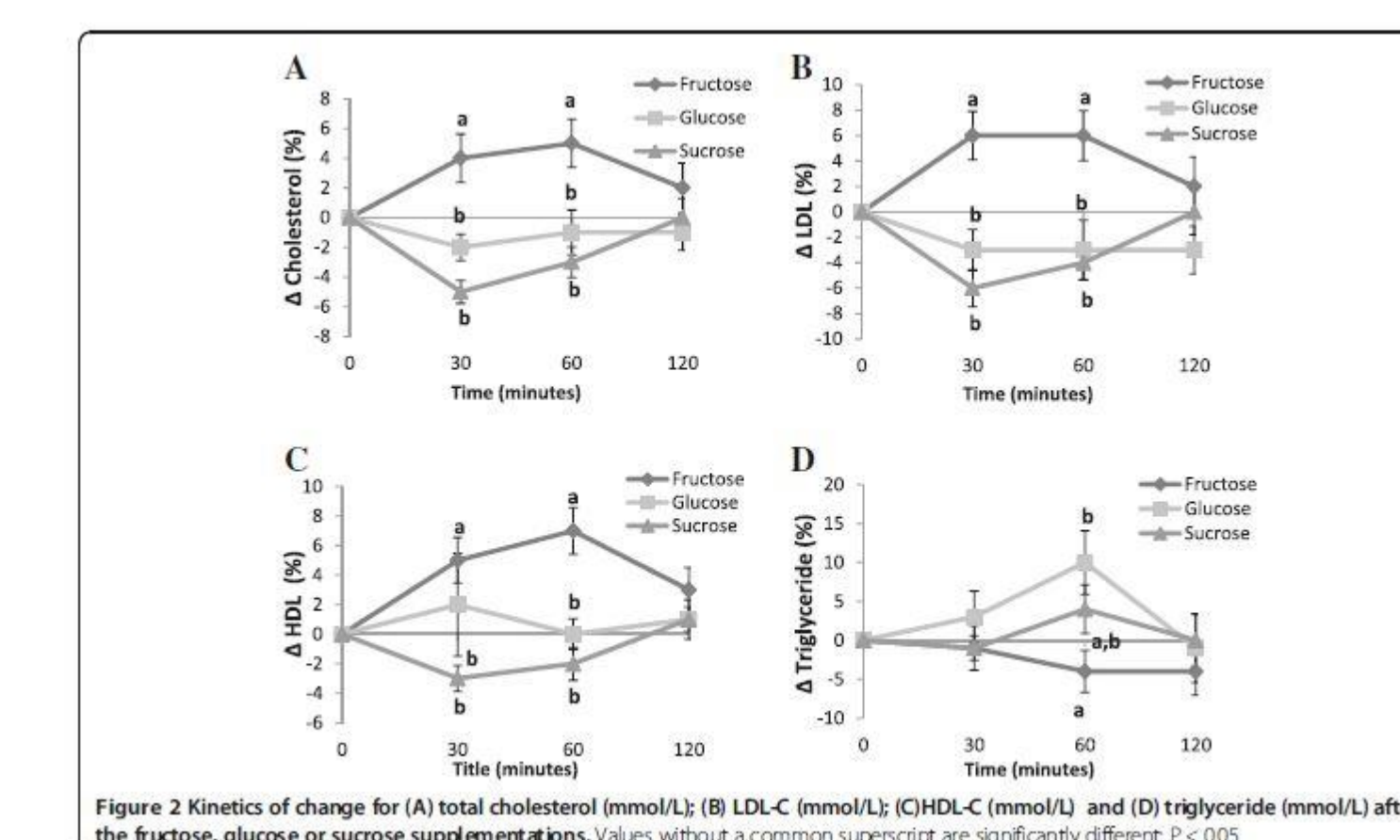
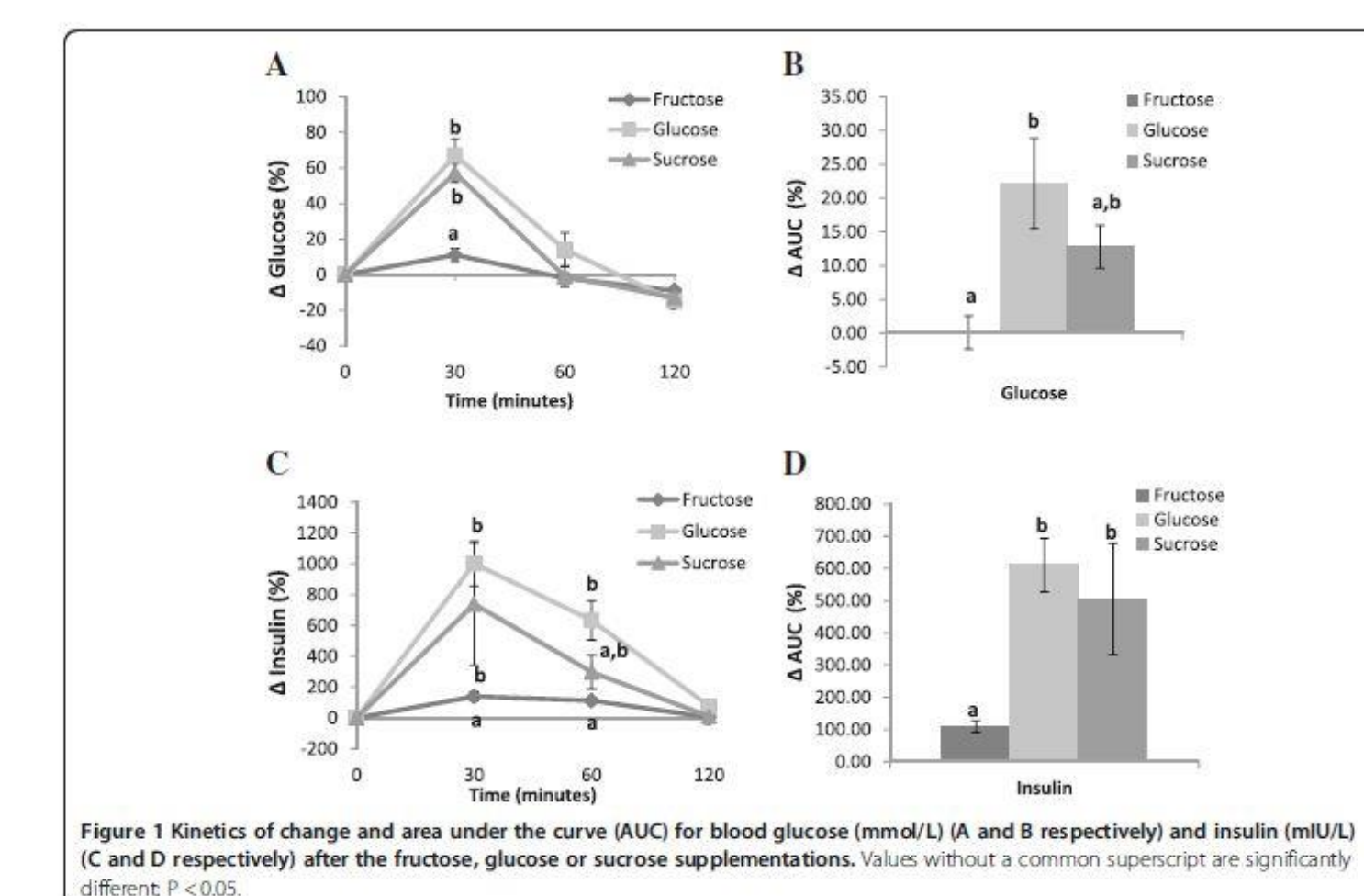
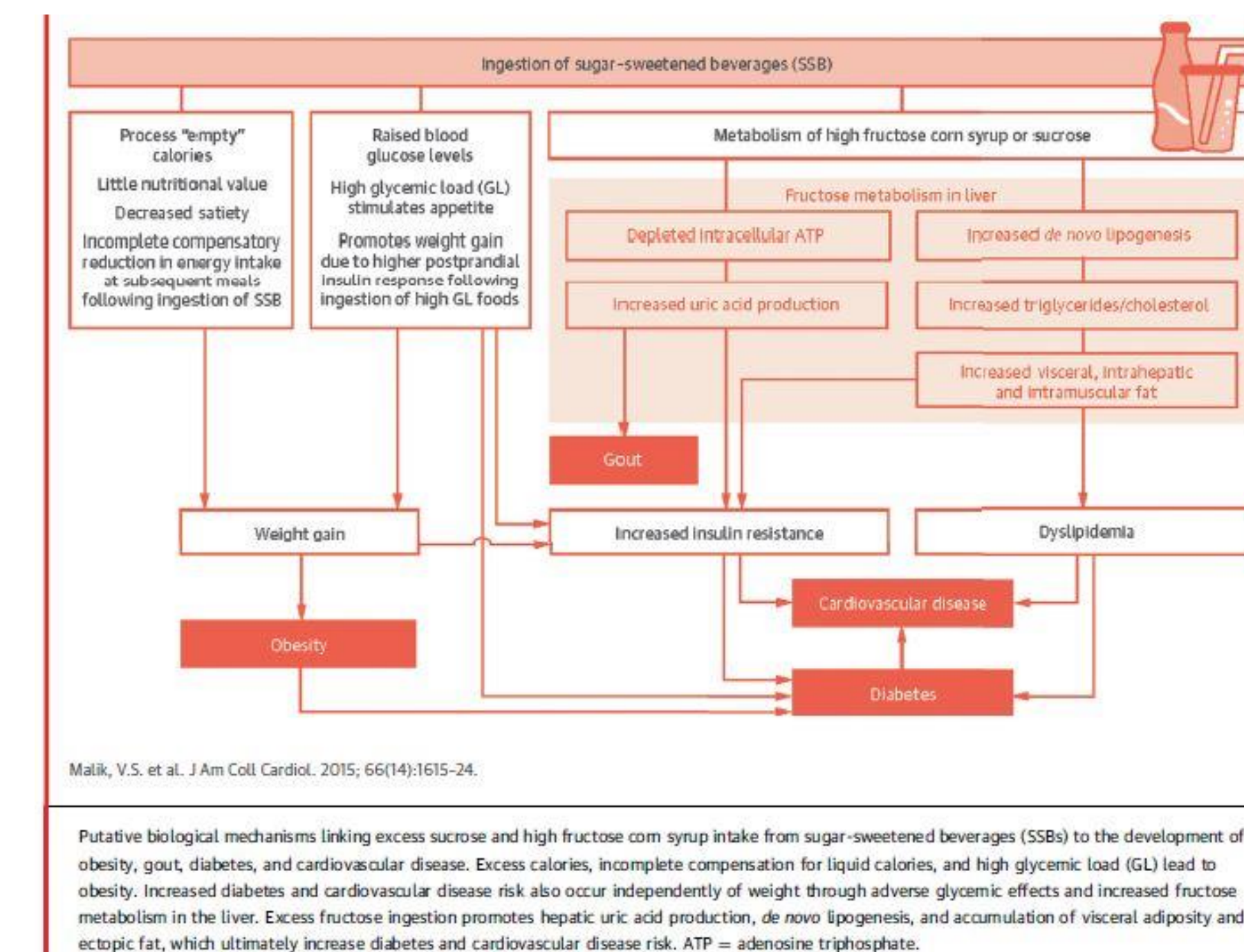
THEME 3: STRUCTURAL AND METABOLIC DIFFERENCES BETWEEN GLUCOSE AND FRUCTOSE

- Same chemical formula, structurally and metabolically different

Glucose and Fructose Molecules



THEME 4: PATHOPHYSIOLOGY OF CARDIOVASCULAR DISEASE AND METABOLIC SYNDROME AND CORRELATION TO FRUCTOSE CONSUMPTION



Discussion

- Fructose appears to have adverse effects on cardiovascular and metabolic health
- It would take a diet with 40% saturated fat to induce an LDL similar to that seen with today’s average fructose intake
- New dietary guidelines limiting added sugar intake need to be implemented
- Alternatives to fructose need to be used in the food manufacturing process

Applicability to Clinical Practice

- Primary care may be the most successful place to educate patients on nutrition
- Reducing fructose intake from sugar sweetened foods and beverages may be the key to weight loss and disease reduction in some patients
- Encourage patients to eat a diet with minimally processed foods—whole grains, fruits, vegetables and unprocessed meats. Simply changing the composition of a patient’s diet can have huge benefits

References

Bray, G. A. (2010). Fructose: Pure, white, and deadly? Fructose, by any other name, is a health hazard. *Journal of Diabetes Science and Technology*, 4(4), 1003-1007. doi:10.1177/19322968100400432

Brown, C. M., Dulloo, A. G., Yepuri, G., & Montani, J. P. (2008). Fructose ingestion acutely elevates blood pressure in healthy young humans. *American Journal of Physiology, Regulatory, Integrative and Comparative Physiology*, 294(3), 730-737. doi:10.1152/ajpregu.00860.2007

Carran, E. L., White, S. J., Reynolds, A. N., Haszard, J. J., & Venn, B. J. (2016). Acute effect of fructose intake from sugar-sweetened beverages on plasma uric acid: a randomized controlled trial. *European Journal of Clinical Nutrition*, 70(9):1034-8. doi: 10.1038/ejcn.2016.112

Chiavaroli, L., de Souza, R. J., Ha, V., Cozma, A. I., Mirrahimi, A., Wang, D. D., ... Slevniņpiper, J. L. (2015). Effect of fructose on established lipid targets: A systematic review and meta-analysis of controlled feeding trials. *Journal of the American Heart Association*, 4(9), 1-24. doi:10.1161/JAHA.114.001700

Chong, M. F., Fielding, B. A., & Frayn, K. N. (2007). Mechanisms for the acute effect of fructose on postprandial lipemia. *The American Journal of Clinical Nutrition*, 85(6), 1511-1520. Retrieved from: <http://ajcn.nutrition.org>

Cinillo, P., Pellegrino, G., Conte, S., Maresca, F., Pacifico, F., Leonard, A., & Trimarco, B. (2015). Fructose induces prothrombotic phenotype in human endothelial cells: A new role for “added sugar” in cardio-metabolic risk. *Journal of Thrombosis and Thrombolysis*, 40(4), 444-451. doi:10.1007/s11239-015-1243-1

Crichton, G. E., & Alkerwi, A. (2014). Whole-Fat dairy food intake is inversely associated with obesity prevalence: findings from the Observation of Cardiovascular Risk Factors in Luxembourg study. *Nutrition Research*, 34(11), 936-43. doi: 10.1016/j.nutres.2014.07.014

D’Nicolantonio, J. J., Lucan, S. C., & O’Keefe, J. H. (2016). The evidence for saturated fat and for sugar related to coronary heart disease. *Progress in Cardiovascular Diseases*, 58(5), 464-472. doi:10.1016/j.pcad.2015.11.006

Elliott, S. S., Keim, N. L., Stern, J. S., Teff, K., & Havel, P. J. (2002). Fructose, weight gain, and the insulin resistance syndrome. *The American Journal of Clinical Nutrition*, 76, 911-922. Retrieved from: <http://ajcn.nutrition.org>

Ferdar, L., Ferdar, M. D., & Inserra, F. (2010). The role of high-fructose corn syrup in metabolic syndrome and hypertension. *Current Hypertension Reports*, 12(2), 105-112. doi:10.1007/s11906-010-0097-3

Iowa Corn Grower’s Association. (2017) *The Facts on High Fructose Corn Syrup*. Retrieved from: <https://www.iowacorn.org/iowa-corn-stalk/2014/02/14/the-facts-on-high-fructose-corn-syrup>

Jameel, F., Phang, M., Wood, L., & Garg, M. (2014). Acute effects of feeding fructose, glucose and sucrose on blood lipid levels and systemic inflammation. *Lipids in Health and Disease*, 13:195. doi: 10.1186/1476-511X-13-195

Johnson, R. J., Nakagawa, T., Sanchez-Lozada, L. G., Shafiq, M., Sundaram, S., Le, M., ... Lanassa, M. A. (2013). Sugar, uric acid, and the etiology of diabetes and obesity. *Diabetes*, 62(10), 3307-3315. doi:10.2337/db12-1814

Kraus, R. M., Eckel, R. H., Howard, B., Appel, L. J., Daniels, S. R., Deckelbaum, R. J., ... Bazzarre, T. L. (2000). Revision 2000: A Statement for Healthcare Professionals From the Nutrition Committee of the American Heart Association. *American Heart Association*. 102:2284-2299. doi: 10.1161/01.CIR.102.18.2284

Malik, V. S., & Hu, F. B. (2015). Fructose and cardiometabolic health: What the evidence from sugar-sweetened beverages tells us. *Journal of the American College of Cardiology*, 66(14), 1615-1624. doi:10.1016/j.jacc.2015.08.025

McCance, K. L., & Huether, S. E. (Eds.). (2014). Alterations in Cardiovascular Function. In *Cunningham’s S. G., Brashers, V. L., & McCance, K. L. (Eds.). Pathophysiology: The Biologic Basis for Disease in Adults and Children* (pp. 1083-1193). St. Louis, MO: Elsevier Mosby.

Office of Disease Prevention and Health Promotion. (2015) *Dietary Guidelines for Americans 2015-2020: 8th Edition*. Retrieved from: <https://health.gov/dietaryguidelines/2015/guidelines/>

Ritterman, J. (2016). Correcting four decades of the wrong dietary advice. *Journal of the American Academy of Physician Assistants*, 29(7), 1-3. doi:10.1097/01.JAA.0000484299.50943.55

Stanhope, K. L., & Havel, P. J. (2008). Endocrine and metabolic effects of consuming beverages sweetened with fructose, glucose, sucrose, or high-fructose corn syrup. *The American Journal of Clinical Nutrition*, 88(6), 1733S-1737S. doi: 10.3945/ajcn.2008.25825D

Stern, K. R. (1997). *Botany Visual Resource Library*. The McGraw-Hill Companies, Inc. Retrieved from: <http://www.mhhe.com/botany/resources/visualresources/015.pdf>

Takir, M., Kostek, O., Ozkok, A., Elcioglu, O. C., Bakan, A., ... Kanbay, M. (2015). Lowering Uric Acid With Allopurinol Improves Insulin Resistance and Systemic Inflammation in Asymptomatic Hyperuricemia. *Journal of Investigative Medicine*, 63(8):924-9. doi: 10.1097/JIM.0000000000000242

Zhang, Y. H., An, T., Zhang, R. C., Zhou, Q., Huang, Y., & Zhang, J. (2013). Very high fructose intake increases serum LDL-cholesterol and total cholesterol: A meta-analysis of controlled feeding trials. *The Journal of Nutrition*, 143(9), 1391-1398. doi:10.3945/jn.113.175323