The Sugar-Fat Seesaw: Achieving a Balanced Diet

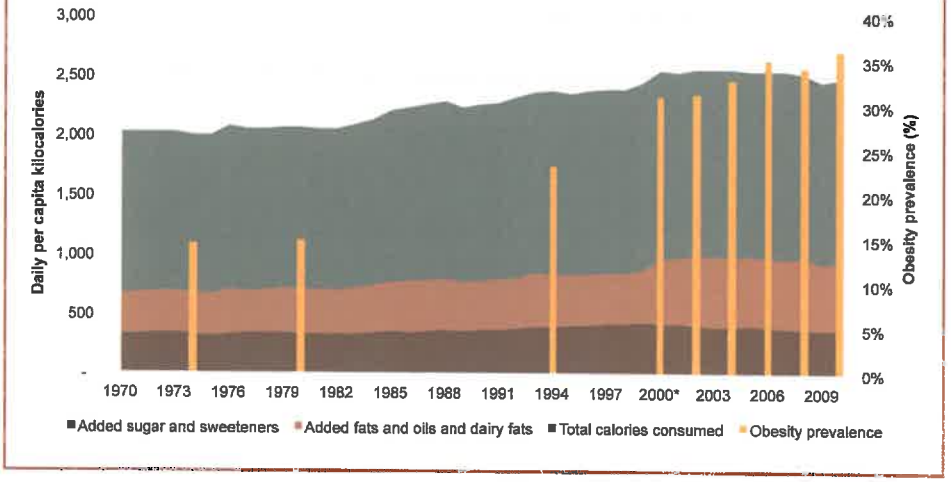
What's a 'Seesaw' Effect?

There is an inverse relationship between the percentage of calories people consume from fat and those consumed from added sugars. In other words, people with diets that are low in fat tend to consume more sugar. The reverse is also true – those with diets high in fat are likely to have low sugar intakes.

Known as a seesaw effect, this phenomenon is confirmed by historical consumption data and observed by researchers.[1] Ultimately, it gets to the heart of most science-based dietary guidance: achieving a balanced diet.

Keeping calorie intake in mind, this seesaw effect highlights the importance of focusing nutrition messaging on a healthful, varied diet. Taking a whole diet approach – versus targeting a specific macronutrient such as fat, protein or carbohydrate – is one way to help reduce obesity in the United States and worldwide. As the data tells us, undue focus on single dietary components is ineffective, and also misses the larger picture of how people actually eat.

Obesity prevalence in US adults and daily per capita total calories and calories consumed from added fats and sugars, 1970 - 2010.



THE NEED FOR A BROADER VIEW

Over the past 50 years, efforts (whether government-led or passing fads) that have targeted individual nutrients – whether sugars or fat or something else –have simply not reduced caloric intake. In fact, they've led to just the opposite – caloric intake has increased dramatically and people are more confused than ever.

The current focus on reducing added sugars exacerbates the increase in fat consumption. Despite lessening health concerns about fat, it remains a major and increasing source of calories, while in parallel, calories from added sugars continue to decline.

Trend data from the United States Department of Agriculture (USDA) indicates there has been a steady decline in per capita consumption of sugars over the past two decades, while both fat and total calories have continued to increase (see chart to the left). To quantify, Americans are consuming more than 450 additional calories each day than they were 40 years ago, with these calories coming mostly from refined grains, added fats and oils. That's equivalent to adding a double cheeseburger on to your total calories every day! Comparatively, added sugars contribute only 8 percent (40 calories) to the daily increase in consumption.[2]

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STABILIZING THE SEESAW

Nutrient Intake

Focusing public health messages too strongly on reducing sugar consumption may mislead the public on the need to also reduce intake of fat and calories overall.

A 2015 systematic review of the evidence suggested the inverse relationship explored here is partially explained by food compositional effects (high-fat foods tend to be low in sugar, and vice versa).[4] With this in mind, meeting dietary recommendations for the percentage of energy intake that should come from both fat and sugars can prove challenging. In fact, most popular diet strategies are prone to seesawing as they typically focus on either a reduction of fat or reduction of carbohydrates (sugars).

Body Mass Index (BMI)

Research observing how this seesaw impacts BMI has found those with higher BMIs tend to be on the high-fat, low-sugar end of the seesaw.

A study published in 2016 examined the diets of more than 100,000 people in the United Kingdom who are part of an ongoing health study. They found that obesity was more strongly associated with total energy intake than any individual macronutrient (fat, carbohydrate or protein), with fat being the biggest contributor to calorie intake and having the strongest association with obesity. There was a positive, but weak, correlation between obesity and absolute energy derived from sugar. However, after controlling for calories, fat remained positively associated with obesity while sugar was negatively associated.[5]

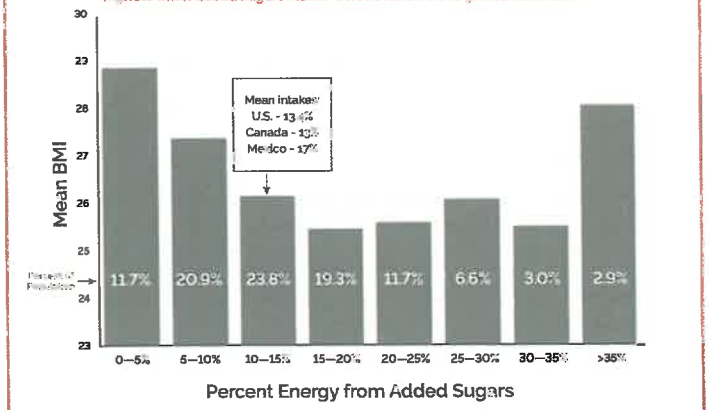
An analysis of data from USDA's What We Eat in America found those who consumed less than 10 percent of energy from added sugars had higher BMIs than those whose energy intake from added sugars fell between 10 and 35 percent (see chart to the right).[6] Those who consumed the lowest percentage of calories from added sugars (0-5 percent of calories) actually had the highest BMIs.

> "Rather than trying to isolate a single dietary culprit, we should focus on the whole picture."
>
> — Alice H. Lichtenstein, DSc
> Tufts University Health & Nutrition Letter

Association Between Added Sugars Intake and BMI

(includes percent of population consuming each range)

A U-shaped relationship exists between added sugars intake and BMI. BMIs are highest when added sugars intake is less than 10% and greater than 35%



*data from USDA's What We Eat in America (2003-2006) (n=15,189) Source: Marriott et al., Crit Rev Food Sci, 2010

THE BOTTOM LINE?

All macronutrients fit within a healthy lifestyle recognizing both sugars and fats are essential components of food. Data has shown the seesaw effect of restricting individual nutrients only leads to caloric overcompensation with another, whether sugar for fat, or vice-versa. When striving for weight control, concentrating on a balanced approach is key to eliminating the sugar-fat seesaw's dizzying ups and downs.

1. Dreher ML, McNeely H, Gibson S. Sugar-fat seesaw: a systematic review of the evidence. Critical Reviews in Food Science and Nutrition. 2014;55(3):328–356. doi:10.1080/10408398.2011.654013.
2. Food availability (per capita) data system: Loss-adjusted food availability documentation. United States Department of Agriculture: Economic Research Service. http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system/documentation.aspx#26705. Updated August 24, 2016. Accessed September 9, 2016.
3. 7 Surprising Sources of Added Sugar. Tufts University Health & Nutrition Letter. June 2015. http://www.nutritionletter.tufts.edu/issues/11_01/current-articles/7-Surprising-Sources-of-Added-Sugar_1720-1.html. Accessed July 25, 2016.
4. Sadler MJ, McNeely H, Gibson S. Sugar-fat seesaw: a systematic review of the evidence. Critical Reviews in Food Science and Nutrition. 2014;55(3):328–356. doi:10.1080/10408398.2011.654013.
5. Anderson JJ, Celis-Morales CA, Mackay DF, et al. Adiposity among 132 479 UK Biobank participants: contribution of sugar intake vs other macronutrients. International Journal of Epidemiology. July 2016. doi:10.1093/ije/dyw173.
6. Marriott BP, Olsho L, Hadden L, Connor P. Intake of added sugars and selected nutrients in the United States, national health and nutrition examination survey (NHANES) 2003–2008. Critical Reviews in Food Science and Nutrition. 2010;50(3):228–258. doi:10.1080/10408390903044223.

Sugar in the Diet: **How Much Are We Actually Consuming?**

A LOOK AT THE FACTS

Did you know the United States Department of Agriculture (USDA) has been monitoring food supply data since 1909? This extensive history shapes our insights on dietary trends and Americans' food intake, which is especially important for helping us understand what's behind today's rates of overweight and obesity.

With that in mind, it should come as no surprise Americans consume more than 450 additional calories each day than we did 40 years ago. People were consuming 2,024 calories each day back in 1970. The most recent calorie data shows by 2010 that figure jumped to 2,481 (nearly a 25 percent increase).[1]

During the past 40 years, the additional calorie consumption has paralleled the rise of obesity. The Centers for Disease Control and Prevention and the National Health and Nutrition Examination Survey showed in the early 1970s, obesity prevalence was 14.5 percent. In 2014, that figure jumped significantly to 37.9 percent. [2,3]

So, how does sugar fit into this?

The latest sugar intake data show that added sugars have only contributed 40 of the additional 457 calories Americans are consuming daily. To drill down even further, USDA data focused on the same period of time shows that per capita consumption of real sugar (i.e., sucrose, or table sugar) is actually one-third lower today than it was in 1970. Similarly, the latest NHANES consumption data estimated a decrease in added sugars by 2.6 teaspoons from 2003-04 to 2011-12. [4]

ALL FOODS FIT... BUT CALORIES COUNT

Excess calorie consumption, combined with sedentary living, is a major contributing factor to the obesity crisis, independent of any single food or nutrient consumed. A recent systematic review of the evidence concluded "if there are any adverse effects of sugar, they are due entirely to the calories it provides."[5] Additionally, three authoritative scientific organizations, including the Institute of Medicine, European Food Safety Authority, and the United Kingdom Scientific Advisory Committee on Nutrition, each conducted extensive scientific reviews of the evidence on "added sugars" and obesity and found no unique role for added sugars.[6,7,8]

The United States' continued focus on the obesity epidemic to assist Americans with achieving healthier weights should place emphasis on individuals reducing their overall food and beverage intake, instead of targeting one isolated component.[9]

"Sugars add desirable sensory effects to many foods, and a sweet taste promotes enjoyment of meals and snacks. In fact, when sugars are added to otherwise nutrient-rich foods, such as sugar-sweetened dairy products like flavored milk and yogurt and sugar-sweetened cereals, the quality of children's and adolescents' diets improves."

-American Heart Association[10]

"Sugars consumed in nutrient-poor foods and beverages are the primary problem to be addressed, not simply sugars themselves. Consumed within recommended calorie amounts, sweetness can offer an effective tool to promote consumption of nutrient-dense foods and beverages."

-American Academy of Pediatrics[10]

Sugar in the Diet: How Much Are We Actually Consuming?

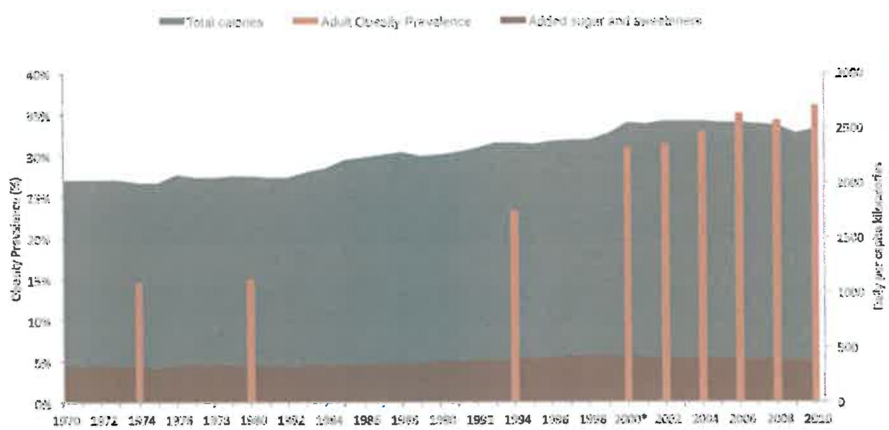
ENSURING A QUALITY DIET

We know calorie balance is essential for weight maintenance, but there's another, very important dimension of planning a healthful diet: nutrient density. A high-quality diet gives the most "bang for your calorie buck," meaning it includes foods that have a higher ratio of vitamins and minerals to the calories they provide.

This is where sugar can play an important role in nutrition. Sugar is often viewed as simply a source of calories that people don't need, while the significant role it plays in a nutrient-rich diet is often not discussed. Decades of research on added sugars in the diet support that sugar helps increase the palatability of healthy foods, making it a key partner in nutrient delivery.[10,11,12,13,14,15,16,17] However, it's important to mention that sugar-containing foods that don't contribute appreciable nutritional value should be treated as, well… treats, and consumed as such within caloric needs.

When you look at the big picture by focusing on the entire nutrient package of a food (versus just one nutrient), sugar can easily be incorporated into a healthy, balanced (and enjoyable!) diet.

Daily per capita Total Calories and Calories consumed from Added Sugars, 1970-2010[20,21,22]



Year	Sugar Intake (tsp)	Obesity Prevalence (%)
1970s	20.8	14.5%
2014	22.9	37.9%
Percent Increase	10%	161%

"Choose a healthy eating pattern at an appropriate calorie level to help achieve and maintain a healthy body weight, support nutrient adequacy, and reduce the risk of chronic disease. To meet nutrient needs within calorie limits, choose a variety of nutrient-dense foods across and within all food groups in recommended amounts."

-Dietary Guidelines for Americans, 2015 – 2020[19]

1. Food availability (per capita) data system: Loss-adjusted food availability documentation. USDA ERS. http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system/loss-adjusted-food-availability-documentation.aspx. Updated August 24, 2016.
2. Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in Obesity Among Adults in the United States 2005-2016. JAMA. 2016;315(21):2284-2291. doi:10.1001/jama.2016.6458
3. Ogden CL, Carroll MD. Prevalence of Overweight, Obesity and Extreme Obesity Among Adults: United States, Trends 1960-1962 Through 2007-2008. National Center for Health Statistics. 2010. https://www.cdc.gov/NCHS/data/hestat/obesity_adult_07_08/obesity_adult_07_08.pdf
4. Bowman SA, Friday JE, Clemens JC, LaComb RP, Moshfegh AJ. A comparison of Food Patterns Equivalents Intakes by Americans: What We Eat in America, NHANES 2003-04 and 2011-12. USDA Food Surveys Research Group. 2016. [illegible]
5. Kahn, R. and Sievenpiper, J. "Dietary sugar and body weight: Have we reached a crisis in the epidemic of obesity and diabetes?" Diabetes Care. 2014;37:957-962. doi: 10.2337/dc13-2506
6. EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA). Scientific Opinion on Dietary Reference Values for carbohydrates and dietary fibre. EFSA Journal. 2010;8(3).
7. Scientific Advisory Committee on Nutrition. Carbohydrates and Health. UK: The Stationery Office Limited (TSO). 2015.
8. Institute of Medicine (U.S.). Panel on Macronutrients., Institute of Medicine (U.S.). Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington, D.C.: National Academies Press; 2005.
9. Anderson JJ, Celis-Morales CA, Mackay DF, et al. Adiposity among 132 479 UK Biobank participants; contribution of sugar intake vs other macronutrients. International Journal of Epidemiology. 2016:173. doi: 10.1093/ije/dyw173
10. Council on School Health, Committee on Nutrition. Snacks, sweetened beverages, added sugars, and schools. Pediatrics. 2015;135(3):575-583.
11. Forshee RA, Storey ML. Controversy and statistical issues in the use of nutrient densities in assessing diet quality. The Journal of Nutrition. 2004;134(10):2733-2737.
12. Food and Agriculture Organization of the United Nations. Carbohydrates in human nutrition: report of a joint FAO/WHO expert consultation. Rome: World Health Organization, Food and Agriculture Organization of the United Nations; 1998.
13. Frary CD, Johnson RK, Wang MQ. Children and adolescents' choices of foods and beverages high in added sugars are associated with intakes of key nutrients and food groups. J Adolesc Health. 2004;34(1):56-63.
14. Murphy MM, Douglass JS, Johnson RK, Spence LA. Drinking flavored or plain milk is positively associated with nutrient intake and is not associated with adverse effects on weight status in US children and adolescents. J Am Diet Assoc. 2008;108(4):631-639.
15. Rennie KL, Livingstone MB. Associations between dietary added sugar intake and micronutrient intake: a systematic review. British Journal of Nutrition. 2007;97(5):832-841.
16. Johnson RK, Appel LJ, Brands M, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. Circulation. 2009;120(11):1011-1020. doi: 10.1161/CIRCULATIONAHA.109.192627
17. Gibson SA. Dietary sugars intake and micronutrient adequacy: a systematic review of the evidence. Nutr Res Rev. 2007;20(2):121-131.
18. American Academy of Pediatrics Policy Statement: Snacks, Sweetened Beverages, Added Sugars, and Schools. Pediatrics 2015;135(3):575-583. doi: 10.1542/peds.2014-3902
19. 2015-2020 Dietary Guidelines for Americans (2015). Available at: http://health.gov/dietaryguidelines[illegible] (Accessed: July 19, 2016)
20. Food availability (per capita) data system: Loss-adjusted food availability documentation (2016) Available at: http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system/loss-adjusted-food-availability-documentation.aspx
21. Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey. Survey Questionnaires, Examination Components and Laboratory Components 2007-2008. CDC website. http://wwwn.cdc.gov/Nchs/Nhanes/Search/nhanes07_08.aspx. (Accessed: July 19, 2016)
22. Kahn, R. and Sievenpiper, J. (2014) 'Dietary sugar and body weight: Have we reached a crisis in the epidemic of obesity and diabetes?', Current Concepts of Type 2 Diabetes Prevention. 37(4), pp. 957-962. doi: 10.2337/dc13-2506.

Sugar and the Glycemic Index: **The Truth is Sweeter Than Fiction**

Think Sugar Ranks High on the Glycemic Index?

Think Again!

THE BASICS: GLYCEMIC INDEX AND GLYCEMIC LOAD

In order to unlock the energy from food and meet basic energy needs, the body must convert the starches and sugars in food into glucose. The glycemic index (GI) is a measure of how quickly the starches and sugars in a food or beverage are broken down to glucose and released into the bloodstream after a food or beverage is consumed. The glycemic load (GL) is determined by multiplying a food's glycemic index by the amount of carbohydrate it contains.[1]

THE WHOLE TRUTH ABOUT SUGAR

As nature's original sweetener, sugar has a moderate GI, similar to that of wheat bread. The table to the right provides GI and GL information for a list of common foods and shows that despite persistent myths, sugar is, in fact, not a high glycemic food.

Rather, coming in at a GI of 58, sugar is only 3 points above the low GI range (of 55 or below) and also has a low glycemic load. The premise that sugar causes a rapid rise in blood glucose (also known as glycemic response), triggering an abnormal production of insulin followed by an atypical drop in blood glucose, is not a physiological or scientific reality. Put simply, sugar ranks somewhere in the middle of carbohydrate foods when it comes to raising blood glucose.

THE GLYCEMIC INDEX DIET, DEBUNKED

The theory behind using GI as a dieting tool fails to recognize that foods are not eaten in isolation. A person's glycemic response to a food can be impacted by numerous factors (see sidebar for a list of these factors) and can vary greatly between individuals, making it a controversial benchmark for a food's nutritional value.[3] To dive even deeper, the same food can affect the same individual differently depending on the activity level before consumption (i.e., after sleep or exercise).[4]

Comparison of Glycemic Index and Glycemic Load of Certain Foods

	Glycemic Index	Glycemic Load
Apple	40	6
Baked Potato	85	26
Brown Rice	50	16
Carrots	92	5
Corn Flakes	92	24
Orange Juice	50	13
Plain Bagel	72	25
Potato Chips	54	11
Wheat Bread	53	11
Table Sugar (Sucrose)	58	6

Ranges for glycemic index (GI) and glycemic load (GL)

	GI	GL
High	70 or more	20 or more
Medium	56 to 69	11 to 19
Low	55 or less	10 or less

K F Powell et al, International table of glycemic index and glycemic load values: 2002, *Am J Clin Nutr* 2002; 76:5-56.

FACTORS INFLUENCING A FOOD'S GI

- Other foods consumed during the same eating occasion
- Cooking method
- Ripeness and storage time
- Processing
- Variety (e.g., short-grain vs. long-grain rice)

Sugar and the Glycemic Index: The Truth is Sweeter than Fiction

WHAT DO THE EXPERTS HAVE TO SAY ABOUT GI?

A number of health-focused organizations and initiatives, including the American Diabetes Association, Academy of Nutrition and Dietetics, Dietary Guidelines for Americans, and Institute of Medicine have evaluated the value of GI/GL.[1,4,5,6] While some of them acknowledge limited utility of these measures, the consistent theme among these evaluations is that GI is not a stand-alone tool on which to base dietary changes; rather, calorie balance/reduction leads to a more profound, positive impact on health, and that includes people with diabetes.

"There is no one diet or meal plan that works for everyone with diabetes. The important thing is to follow a meal plan that is tailored to personal preferences and lifestyle and helps achieve goals for blood glucose, cholesterol and triglyceride levels, blood pressure, and weight management. Research shows that both the amount and the type of carbohydrate in food affect blood glucose levels. Studies also show that the total amount of carbohydrates in food, in general, is a stronger predictor of blood glucose response than the GI. Based on the research, for most people with diabetes, the first tool for managing blood glucose is some type of carbohydrate counting."

- American Diabetes Association

"A food's GI ranking only applies when a food is consumed on an empty stomach without any other type of food. As anyone who's ever eaten food knows, this isn't always how we eat. Sure, a bag of pretzels may be a stand-alone snack, but how often do we eat just a plain potato with nothing else? Add a lean steak or a piece of salmon, a side of broccoli and a salad with vinaigrette, and the protein, fiber and fat will all serve to lower the glycemic index. In addition, the glycemic index doesn't take into account how much we're actually consuming."

- Academy of Nutrition and Dietetics

THE BIG PICTURE

The moral of the story is as follows: using measures like GI and GL can be useful in determining how quickly a food item, when eaten alone, will break down in the body. However, a recent study shows GI may not be the best approach for food guidance.[7] Planning a nutritious diet comes down to balance and variety of food choices. As recommended by the Dietary Guidelines for Americans, 2015 – 2020, a healthy eating pattern includes fruits, vegetables, whole grains, dairy and protein foods and allows the flexibility to also add sugar.[8]

And, what links all of this advice together? At the end of the day, all foods in a healthy eating pattern must fit within a recommended number of calories.

1. Glycemic Index and Diabetes. American Diabetes Association. http://www.diabetes.org/food-and-fitness/food/what-can-i-eat/understanding-carbohydrates/glycemic-index-and-diabetes.html? Updated May 2014. Accessed: 19 July 2016.
2. Nutrition recommendations and interventions for diabetes. American Diabetes Association. 2007;30(1):48–65. doi: 10.2337/dc07-S048
3. Foster-Powell K, Holt SH, Brand-Miller JC. International table of glycemic index and glycemic load values: 2002. The American Journal of Clinical Nutrition. 2002;76(1):5–56.
4. Zeevi D, Korem T, Zmora N, et al. Personalized Nutrition by Prediction of Glycemic Responses. Cell. 2015;163(5):1079–94.
5. Otten J, Hellwig J, Meyers L. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Institute of Medicine. https://fnic.nal.usda.gov/sites/fnic.nal.usda.gov/files/uploads/DRIEssentialGuideNutReq.pdf. Published 2006. Accessed: 19 July 2016.
6. Kimber M. What is Glycemic Index? Eat Right. Academy of Nutrition and Dietetics. http://www.eatright.org/resource/food/nutrition/dietary-guidelines-and-myplate/what-is-glycemic-index. Published February 5 2014. Accessed: 19 July 2016.
7. Matthan NR, Ausman LM, Meng H, Tighiouart H, Lichtenstein AH. Estimating the Reliability of Glycemic Index Values and Potential Sources of Methodological and Biological Variability. Am J Clin Nutr. 2016; doi: 10.3945/ajcn.116.137208.
8. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015–2020 Dietary Guidelines for Americans. 8th Edition. ODPHP. http://health.gov/dietaryguidelines/2015/. Published December, 2015. Accessed: 19 July 2016. Matthan NR, Ausman LM, Meng H, Tighiouart H, Lichtenstein AH. Estimating the reliability of glycemic index values and potential sources of methodological and biological variability. Am J Clin Nutr. 2016; doi: 10.3945/ajcn.116.137208.