What’s new in the world of carbohydrates

Joanne Slavin, PhD, RD, Disclosures

<table>
<thead>
<tr>
<th>AFFILIATION/FINANCIAL INTERESTS (past 12 months)</th>
<th>CORPORATE ORGANIZATION</th>
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<td>Grants/Research Support:</td>
<td>Mushroom Council, Nestle, DSM, USDA, ILSI, Welch’s</td>
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<td>Scientific Advisory Board/Consultant:</td>
<td>Kerry, Atkins, Tate and Lyle, Midwest Dairy Association</td>
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<td>Speakers Bureau:</td>
<td>Stock Shareholder:</td>
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<td>Other:</td>
<td>1/3 interest in Slavin Sisters Farm, 119 acres, Walworth, WI</td>
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Learning Objectives

After completing this continuing education course, nutrition professionals should be able to:

1. Discuss the latest science behind carbohydrate recommendations.
2. Understand the key guidance relating to carbohydrates in the DGAs.
3. Identify regulations that have been implemented relating to carbohydrates in foods.
4. Communicate to patients evidence-based recommendations for consuming carbohydrates.
Outline

• The science behind carbohydrate recommendations
• Dietary guidance for carbohydrates
  – 2015 DGAs
• Regulations for carbohydrates
  – Added sugars on Nutrition Facts panel
  – Changes in fiber
• Communicating carbohydrates

From the Science to Me

The Science                               Policy                             Me

Carbohydrates in the Diet

• Vegetables, fruits, grains, legumes, and milk are main food sources of carbohydrates
• Grains and certain vegetables (potatoes, corn) high in starch (glucose) – except sweet potatoes (sucrose)
• Fruits and green vegetables contain little starch – fruits mostly sugar
  – Apples and pears high in fructose (66%), most other fruits 50/50 glucose/fructose (sucrose); milk 50/50 glucose/galactose
• Sugar can be isolated from sugar beets, sugar cane or manufactured from starch (corn sugar)
Differences in Carbohydrates

- Chemical structure – mono, di, polysaccharide
  - Mono: few in food supply; fructose in apples and pears
  - Di: sucrose (glucose, fructose) and lactose (glucose, galactose)
  - Poly: starch
- Digestible vs. non-digestible
- Speed of digestion and absorption – Glycemic index
- Physical structure – in solution, part of a food, associated substances (protein), part of a seed or grain, particle size

US Carbohydrate Label

Total carbohydrate – measured by difference
- Lists sugar – total – although movement to list added sugar
- List dietary fiber – soluble and insoluble
- No information on glycemic index, resistant starch, sugar alcohols, whole grain – unless provided by manufacturer

Dietary Guidance on Digestible CHOs

- RDA of 130 grams of carbohydrate per day
- 45%–65% of calories should come from carbohydrate (AMDR)
- Carbohydrates are the fill after protein needs are met – high-calorie diets should be high in carbohydrate (sports nutrition)
- Added sugar – 25% or less of calories – based on nutrient dilution, not link to negative health status
Calcium Intake in Children 4-8 Y as a Function of Added Sugar Intake

<table>
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<tr>
<th>% Added Sugars</th>
<th>Calcium, mg/day</th>
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<tr>
<td>0-5</td>
<td>600</td>
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<tr>
<td>5-10</td>
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(Dietary reference intakes for adequacy: calcium and vitamin D, Institute of Medicine, 2011)

Intrinsic vs. Extrinsic Sugars

- Intrinsic sugar — sugars that are naturally occurring within a food
- Extrinsic sugars – those added to food AKA “added sugar”
- No difference in the molecular structure of sugar molecules, whether they are naturally occurring in the food or added to the food
- No analytical method to differentiate between added sugar and intrinsic sugar

Senate Select Committee on Nutrition and Human Needs – Dietary Goals in the United States (1977)

- Increase carbohydrates to 55%–60% of energy
- Reduce fat to 30% of energy
- SF, MF, PUFAs – 10%/10%/10%
- Reduce cholesterol to 300 mg/day
- Reduce sugar consumption by 40%
- Reduce salt consumption to 3 g/day – 1200 mg sodium
Evidence Analysis Methodology

- Rigorous
- Minimizes bias
- Transparent
- Accessible to stakeholders and consumers
- Defines state of the science
- Foundation for updates

Answers precise questions • Illuminates research gaps
Nutrition Evidence Library (NEL) Process

Formulate Systematic Review Questions
- Exploratory searches
- Public comment
- Dialogue with experts
- Analytical Framework
- PICO

Literature Search and Sort
- Identify study eligibility criteria
- Determine search strategy
- Search for relevant studies
- List included studies
- List excluded studies and rationale

Extract Evidence From Studies
- Create evidence worksheets

Summarize and Synthesize the Evidence
- Assess quality of individual studies
- Assess applicability
- Summarize and synthesize evidence

Develop and Grade Conclusion Statements

Define Research Recommendations

Hierarchy of Evidence

Stronger Evidence
- RCT
- Double Blinded Intervention study
- Prospective, cohort study
- Clinical trial
- Cross-sectional study
- Case Report
- Expert Opinion

Weaker Evidence

Grade Strength of Evidence

- Quality
  - Scientific rigor and validity
  - Consider study design and execution
- Quantity
  - Number of studies/sample sizes
- Consistency of findings across studies
- Impact
  - Importance of studied outcomes/magnitude of effect
  - Magnitude of effect
- Generalizability
- Grades: 1. STRONG; 2. MODERATE; 3. LIMITED
In Adults, What are the Associations Between Intake of Sugar-sweetened Beverages and Energy Intake and Body Weight?

- Limited evidence shows that intake of sugar-sweetened beverages is linked to high energy intake in adults.
- A moderate body of epidemiologic evidence suggests that greater consumption of sugar-sweetened beverages is associated with increased body weight in adults.
- A moderate body of evidence suggests that under isocaloric controlled conditions, added sugars, including sugar-sweetened beverages, are no more likely to cause weight gain than any other source of energy.

Added Sugar

- Measurement of “added sugar” in studies is inconsistent making study comparisons difficult – easier to count SSB.
- Added sugar not different than other extra calories in the diet for energy intake and body weight.
- Added sugar reduction – based on calorie reduction, not association of added sugar and health outcomes.

2010 DGAC Carbohydrate Chapter Summary

- Healthy diets are high in carbohydrate. AMDR for carbohydrates are 45 – 65%. A maximum intake of 25% of added sugars is suggested.
- Americans should choose fiber-rich foods such as whole grains, vegetables, fruits, and cooked dry beans and peas as staples in the diet. Dairy products are also a nutrient-dense source of carbohydrates.
- Carbohydrates are the primary energy source for active people. Sedentary people, including most Americans, should decrease consumption of caloric carbohydrates to balance energy needs and attain and maintain ideal weight.
The Purpose of the Dietary Guidelines for Americans

• “Designed for professionals to help all individuals ages 2 years and older ... consume a healthy, adequate diet.”

• “Develop food, nutrition and health policies and programs.”

The Dietary Guidelines for Americans: The Cornerstone of US Nutrition Policy & Regulation

The Science Behind the Guidelines

Dietary Guidelines Advisory Committee considers:

* Original systematic scientific reviews
* Existing systematic reviews, meta-analyses and scientific reports
* Dietary data analyses
* Food pattern modeling analyses

Issues technical report with nutrition and health recommendations

DHHS/USDA uses technical report and comments to develop updated Dietary Guidelines

Scientific rationale based on various research methods:
2015-2020 DGA: A Snapshot

Provides 5 Overarching Guidelines:
1. Follow a healthy eating pattern across the lifespan.
2. Focus on variety, nutrient density, and amount.
3. Limit calories from added sugars and saturated fats and reduce sodium intake.
4. Shift to healthier food and beverage choices.
5. Support healthy eating patterns for all.

A healthy pattern includes:
- A variety of vegetables
- Fruits, especially whole fruits
- Grains, at least half of which are WG
- Fat-free/low fat dairy, including milk & yogurt
- A variety of protein foods
- Oils

A healthy pattern limits:
- Sat fat: <10% of calories/day
- Trans fat: keep as low as possible
- Added sugars: <10% of calories/day
- Sodium: < 2,300 mg of sodium/day

Shift from Individual Foods and Ingredients to Healthy Eating Patterns!

A Healthy Pattern Includes: Vegetables & Fruits

- What's the recommendation?
  - 2½ cups vegetables; 2 cups fruits daily
  - Intakes remain significantly below recommended amounts
    - Vegetables: 87% have intakes below goal
    - Fruits: 75% have intakes below goal
- What's changed since 2010?
  - Similar to 2010 recommendations:
    - Vegetables: A variety of vegetables from all subgroups - dark green, red and orange, legume, starchy and other
    - Fruit: especially whole fruit

A Healthy Pattern Includes: Grains

- What's the recommendation?
  - At least half of grain intake should be whole grain
  - Continued imbalance of intake between refined grain and whole grain
  - Enriched/fortified grain recognized as important source of folic acid
  - Recommendation for most adults: 6 ounce equivalents of Grain foods per day
    - At least 3 should be whole grain
- What's changed since 2010?
  - Similar to 2010 recommendations:
  - Differences from 2010 recommendations:
    - 16g whole grain = 1 whole grain ounce-equivalent
      - Progression from 2010!
    - Acknowledgement that whole grains vary in fiber content
- What's the scientific basis?
  - Systematic Reviews, Modeling
A Healthy Pattern Includes: Dairy

- What's the recommendation?
  - 3 cups for ages 9+
  - Choose fat-free or low-fat dairy, including milk, yogurt, cheese and/or fortified soy beverages
- Almost everyone falls short!
- What's changed since 2010?
  - Similar to 2010 recommendations:
    - 2 cups for ages 2-3 years, 2.5 cups for ages 4-8 years, 3 cups for ages 9+
    - Choose fat-free or low-fat dairy foods
  - Differences from 2010 recommendations:
    - Choose fat-free and low-fat dairy options with little to no added sugars
    - Choose milk and yogurt over cheese to reduce saturated fat and sodium
- What's the scientific basis?
  - Systematic Reviews, Modeling

A Healthy Pattern Limits: Added Sugars

- What's the recommendation?
  - Less than 10% calories per day from added sugar
    - Current intakes average >13% of calories, ~270 calories/day
    - Nutrient-dense foods with added sugars OK within limits (e.g. fat-free yogurt and whole grain breakfast cereals)
- What's changed since 2010?
  - Similar to 2010 recommendations:
    - Reduce added sugar consumption
  - Differences from 2010 recommendations:
    - First-time quantitative number
- What's the scientific basis?
  - World Health Organisation Systematic Review, Modeling
  - Acknowledgement that evidence is still developing

Fiber Agreement

- Marker of a healthy diet
  - whole grains, fruits, vegetables, legumes
- Concept
  - carbohydrates and lignin that escape digestion in the upper GI tract but may be fermented in the gut
- Requirement in the diet
  - according to 2002 Dietary Reference Intakes (DRIs)
- Regulated
  - On the Nutrition Facts panel – 25 g Daily Value (DV)
- Health claims
  - oat bran, barley bran, and psyllium and CVD in US
Dietary Fiber (Institute of Medicine, 2001)

Dietary fiber – carbohydrates and lignin that are intrinsic and intact in plants

- Found in grains, vegetables, legumes, fruit
- Accepted physiological effects include laxation, attenuation of blood glucose, normalization of serum cholesterol
- Measured by challenging chemical methods

Functional Fiber (Institute of Medicine, 2001)

Functional fiber – isolated or purified carbohydrates not digested and absorbed that confer beneficial physiological effects

- Laxation (wheat bran, psyllium)
- Normalization of blood lipid levels (oat bran, barley bran, psyllium)
- Attenuation of blood glucose (guar gum, psyllium)
- Other effects
  - Weight management – satiety, lower fat absorption, weight loss
  - Blood pressure control
  - Gut environment – microflora, fermentation, transit time

What Are the Health Benefits of Dietary Fiber?

A moderate body of evidence suggests that dietary fiber from whole foods protects against cardiovascular disease, obesity, and type 2 diabetes and is essential for optimal digestive health
Relative Risk of Death From CHD

[Graph showing relative risk of death from CHD against total energy-adjusted dietary fiber intake.]

(Pereira et al, Arch Intern Med, 2004)

Can the Chemical Structure of Fiber Predict Physiological Effects?

- Original concept that solubility predicts physiological effects no longer accepted
- Viscosity – may predict some digestive effects, but inconsistent – and viscosity where?
- Fermentation – important, but difficult to study in vivo and does not predict physiological effects
- Physical structure – in solution, part of a food, associated substances (protein), part of a seed or grain, particle size

Summary of Tolerance Data

(Grabitske & Slavin, 2009)

- Dietary fiber – up to 80 g/d in vegetarians – no UL
- Resistant starch – 80 g
- Fructo-oligosaccharides – 10-15 g – diarrhea at 40 g
- FODMAP – fermentable oligo, di and mono-saccharides and polyols
  – Most of published studies from Australia – interest with low gluten and IBS patients

(Grabitske and Slavin, Crit Rev Food Sci Nutr, 2009)
Prebiotics and the Health Benefits of Fiber: Current Regulatory Status, Future Research & Goals

- No prospective, cohort studies that link changes in microbiota with health outcomes – fecal samples not collected in epidemiologic studies
- Disagreement on how to measure microbiota (quantitative) in human studies
- Prebiotic standard protocols needed

(References: Brownawell et al., J Nutr, 2012)

Metabolic Benefits of Dietary Prebiotics

- Review from 2000 – 2013
- 26 trials, 831 participants
- Increased satiety, reduced postprandial glucose and insulin
- No effects on energy intake, body weight, peptide YY, GLP-1, gastric emptying time, insulin sensitivity, lipids, inflammatory markers, and immune function

(References: Keillow, Coughlan, and Reid, Br J Nutr, 2014)

Gut Microbiota Influence Metabolism & Body Composition

(References: Vrieze et al., Diabetologia, 2010)
Proposed FDA Definition for Dietary Fiber

1. Non-digestible soluble and insoluble carbohydrates (with 3 or more monomeric units) and lignin that are intrinsic and intact in plants

2. Isolated and synthetic non-digestible carbohydrates (with 3 or more monomeric units) that FDA has granted be included in the definition of dietary fiber, in response to a petition submitted to FDA – process not determined

3. Isolated and synthetic non-digestible carbohydrates (with 3 or more monomeric units) that are the subject of an authorized health claim

Other Proposed Changes for Fiber

- Current regulations are 4 kcal/g for soluble and 0 kcal/g for insoluble fiber
- Proposed is 2 kcal/g for soluble and 0 kcal/g for insoluble fiber
- Proposed to increase DRV for fiber from 25 g to 28 g for 2000 kcal diet
- Soluble and insoluble fiber will continue to be voluntary on label

Dietary Fiber Intake is Low

- Typical fiber intake in US is 15 grams per day –
- 95% of Americans don’t get recommended intake of fiber – nutrient of concern in Dietary Guidelines for Americans
- Most fiber-containing foods – 1 – 3 g of fiber
  - Apple – 2 grams
  - Lettuce – 1 gram
  - WW bread – 2 grams
  - Oatmeal – 3 grams
- Refined grains and white potatoes important fiber sources in the US diet because they are widely consumed
- Interest in the addition of functional fibers to the food supply to increase fiber intake

(Periy, J Am Diet Assoc, 2008)
Food Advice: Evolution of USDA’s Food Guidance – Moderation & Variety

MyPlate.gov (6/2/11)

Conclusions

- Evidence-based reviews are limited in our ability to define “healthy foods”
- Healthy carbohydrates include foods rich in fiber and starch – whole grains, vegetables, and legumes
- Healthy carbohydrates also include foods rich in fiber and sugar – fruits, dairy products
- Expect to see a 10% DV for added sugars in 2016. The 2015 DGAC is the scientific support for such a recommendation.
- Nutrition Facts panel revision includes DV for added sugars (10%) and new rules for dietary fiber labeling including a new DV for total fiber (28 grams per day)
Credit Claiming

You must complete a brief evaluation of the program in order to obtain your certificate. The evaluation will be available for 1 year; you do not have to complete it today.

Credit Claiming Instructions:
1. Go to www.CE.TodaysDietitian.com/SlavinCarbs, OR Log in to www.CE.TodaysDietitian.com and go to “My Courses” and click on the webinar title.
2. Click “Take Course” on the webinar description page.
3. Select “Start/Resume” Course to complete and submit the evaluation.
4. Download and print your certificate.

Please Note: If you access the Evaluation between 3-4 pm ET on 11/3, you may experience a slow connection due to a high volume of users.