

# The Role of Carbohydrate as Delivery Vehicle for Nutrients

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## Disclosures

- ▶ Science Advisory Panel – Potatoes USA
- ▶ Consultant – National Cattlemen's Beef Association
- ▶ Consultant – Dyets, Inc.
- ▶ Project Reviewer – USDA/ARS

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## Carbohydrate Issues–1

- ▶ No generally accepted definition of low-CHO diet
  - DGA range is 45–65% energy
    - at 45%, 180 g CHO in a 1,600 kcal diet (10th percentile)
- ▶ Nutrients of public health concern
  - Added sugar, sodium, saturated fat, dietary fiber, potassium, calcium, vitamin D
- ▶ Rice, wheat, maize provide >50% energy
  - Grains can be dried, stored for long periods, easily transported, cooked into a variety of products, price

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## Carbohydrate Issues–2

- ▶ Wheat flour fortified with folate
  - Women who could become pregnant should not restrict?
- ▶ Enriched rice and corn meal/flour
  - B1, B3, iron required in schools, nonprofits for rice
- ▶ Concept of nutrient-dense foods
  - Independent of CHO content
  - Do CHO simply fill in calories?
  - Provide dietary fiber, resistant starch, numerous polyphenols, carotenoids, other bioactives
- ▶ Now must consider chronic disease in DRI
  - Consider carbohydrate quality?

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## Current U.S. Carbohydrate Intake (g/d) NHANES 2015–18

|              | 5th | 50th | 95th | <EAR |
|--------------|-----|------|------|------|
| Males 19+    | 149 | 273  | 439  | <3%  |
| Females 19+  | 117 | 209  | 333  | <3%  |
| Total Sugars |     |      |      |      |
| Males 19+    | 45  | 110  | 223  |      |
| Females 19+  | 38  | 89   | 173  |      |

~4900 people in each line

RDA for CHO 130 g/d

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**TABLE 2 2. Top 25 Sources of Calories Among Americans Ages 2 Years and Older, NHANES 2005–2006<sup>a</sup>**

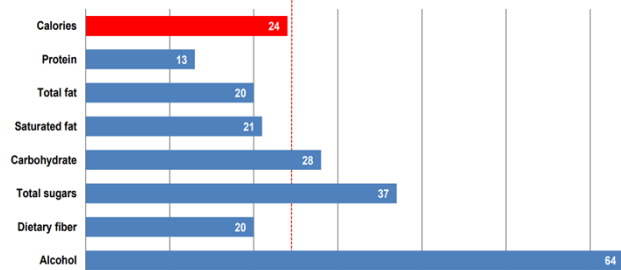
| Rank | Overall, Ages 2+ yrs<br>(Mean kcal/d; Total daily calories = 2,157) | Children and Adolescents, Ages 2–18 yrs<br>(Mean kcal/d; Total daily calories = 2,027) | Adults and Older Adults, Ages 19+ yrs<br>(Mean kcal/d; Total daily calories = 2,199) |
|------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1    | Pizza (136 kcal)                                                    |                                                                                        |                                                                                      |
| 2    | Chicken and chicken mixed dishes <sup>d</sup><br>(121 kcal)         |                                                                                        | Chicken and chicken mixed dishes<br>(123 kcal)                                       |
| 3    | Pizza (98 kcal)                                                     |                                                                                        |                                                                                      |
| 4    | Chicken and chicken mixed dishes<br>(113 kcal)                      |                                                                                        |                                                                                      |
| 5    | Pizza (86 kcal)                                                     |                                                                                        |                                                                                      |
| 6    | Tortillas, burritos, tacos (85 kcal)                                |                                                                                        |                                                                                      |
| 7    | Dairy desserts (76 kcal)                                            |                                                                                        |                                                                                      |
| 8    | Beef and beef mixed dishes <sup>b</sup> (64 kcal)                   |                                                                                        |                                                                                      |
| 9    | Dairy desserts <sup>c</sup> (62 kcal)                               |                                                                                        |                                                                                      |
| 10   | Dairy desserts (58 kcal)                                            |                                                                                        |                                                                                      |

#1 in source of calories in adults in NHANES in 1988–94 and 1999–2000 was soft drinks (7.1% en), followed by grain-based desserts (3.6% en) (G Block, J Food Comp Anal, 2004;17:439.)

HHS/USDA. Dietary Guidelines for Americans, 2010

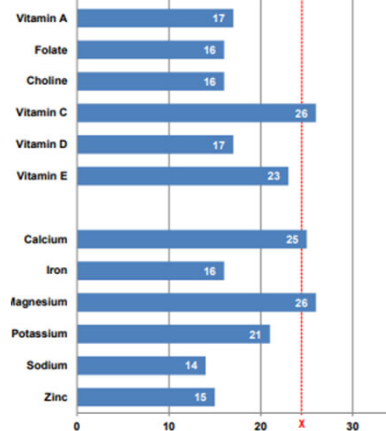
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**Figure 3. Snacks' contributions to intakes of nutrients and other food components by adults age 20 years and over, WWEIA, NHANES 2007-2008**



RS Sebastian et al, 2011, WWEIA Dietary Data Brief No. 4

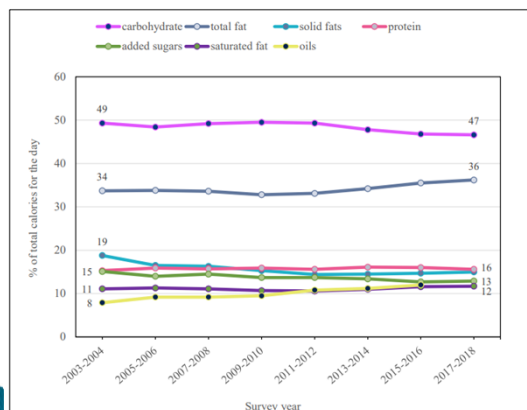
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RS Sebastian et al, 2011, WWEIA Dietary Data Brief No. 4

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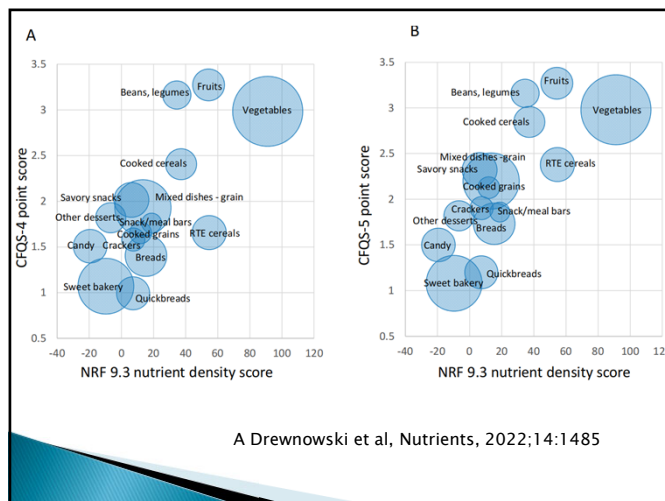
Figure 6. Estimated mean percentage of calories obtained from macronutrients, added sugars, solid fats, and oils by adults from 2003-2004 to 2017-2018, WWEIA, NHANES, day 1



S. Bowman,  
WWEIA Data  
Brief No. 35,  
2021

All percentages of calories, except protein, were significantly different at  $p < 0.01$  between 2003-2004 and 2017-2018. The linear trends were significant at  $p < 0.01$  for all, except protein.

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A Drewnowski et al, Nutrients, 2022;14:1485

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► C. Churuangsk et al. Impacts of carbohydrate-restricted diets on micronutrient intakes and status: A systematic review. *Obes Rev.* 2019;20:1132

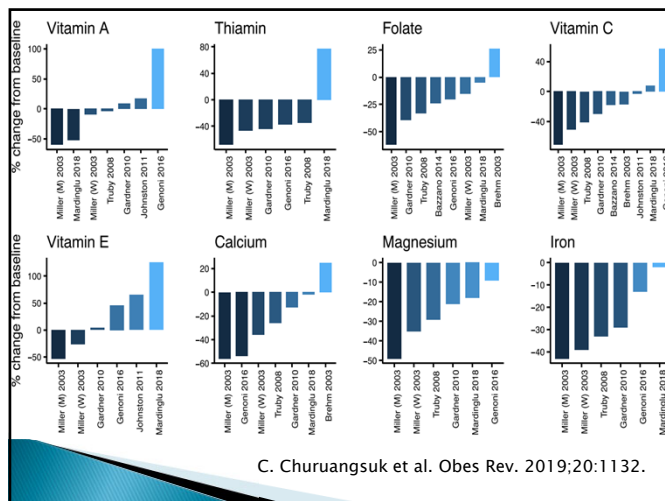
► 10 studies

- 7 RCTs (5 Atkins; 2 paleo)
- 2 Atkins uncontrolled
- 1 cross-sectional

► CHO intake 4–34% energy over 2–104 weeks

► Iodine deficiency symptoms in one paleo study

► Risk of multiple vitamin/mineral deficiencies



C. Churuangsk et al. *Obes Rev.* 2019;20:1132.

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► C. Zinn et al. Assessing the nutrient intake of a low-carbohydrate, high-fat (LCHF) diet: a hypothetical case study design. *BMJ Open* 2018; 8:e018846.

- CHO <130 g/d (26% en), protein 15–25% en
- Diets provided **2200–2800 kcal/d**
- All meal plans exceeded Aust/NZ NRV except iron
- Some meals exceeded sat. fat limit
- Fiber from vegetables, limited fruit, lots of nuts and seeds, exceeded 35 g/d – zero whole grains

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► C. Zinn et al. Assessing the nutrient status of low carbohydrate, high-fat (LCHF) meal plans in children: a hypothetical case. *Nutrients* 2022; 14:1598.

- Diets designed for weight stable 11 & 16 yr olds
  - **2016–2968 kcal/d**
- CHO ≤80 g, “selected as midpoint between 130 g and ketogenic diet limit of 50 g/d”
  - CHO was mostly sugar, not starch but included some whole grains
- Met all Aust/NZ NRV

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► H. Jebeile et al. Low-carbohydrate interventions for adolescent obesity: Nutritional adequacy and guidance for clinical practice. *Clin Obes*, 2020;10:e10370.

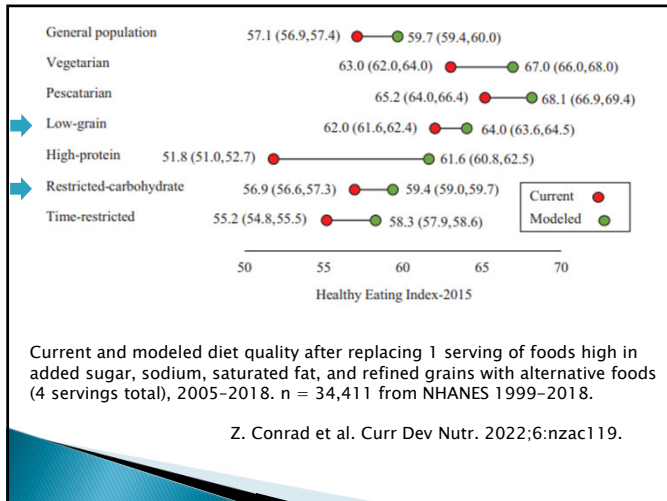
- Weight loss diets 1510–1730 kcal/d
- CHO ≤30, ≤50, or ≤120 g/d (7, 13, 26% en)
- Fiber at 18, 21, or 29 g/d
- Sat fat (11.3–17.1%) exceeded limit in all diets
- 10+ servings of vegetables daily plus 2–3 nut servings, plus 1–2 berry servings
- Limited options for lower CHO meal plans

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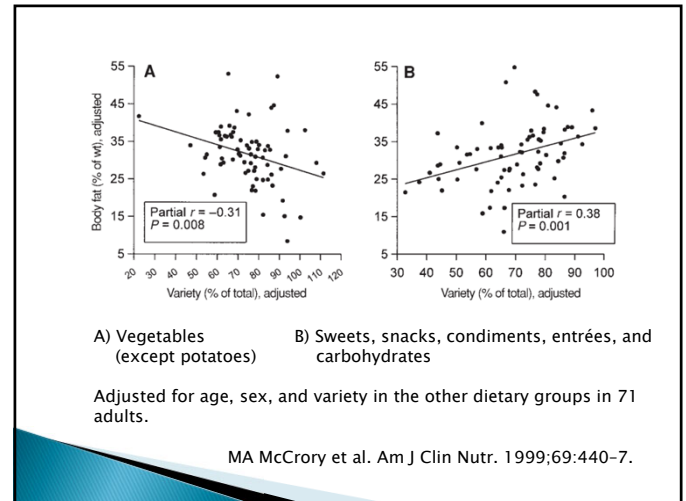
► FT McSwiney and L Doyle, Low-carbohydrate ketogenic diets in male endurance athletes demonstrate different micronutrient contents and changes in corpuscular haemoglobin over 12 weeks. *Sports*. 2019;7:201.

- At week 12, **HC (65% en)** diet participants had greater intakes of carbohydrate, fiber, sugar, sodium, chloride, magnesium, iron, copper, manganese and thiamine, with higher glycemic load (GL), compared to **LCKD (<50 g/d)** participants (P < 0.05). LCKD participants had greater intakes of saturated fat, protein, a higher omega 3:6 ratio, selenium, vitamins A, D, E, K1, B12, B2, pantothenic acid and biotin. Mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) decreased in LCKD participants after 12 weeks but remained unchanged in HC participants.

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