Impact of postprandial glycaemia on health, body weight control and diabetes prevention

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On behalf of ILSI Europe convened expert panel

Diet + Exercise ➔ body composition + metabolic status ➔ diabetes type 2 risk

If you want to understand diet – diabetes risks then start understanding food
We do not consume food components in isolation
Dietary factors and low-grade inflammation in relation to overweight and obesity

British Journal of Nutrition
Volume 106 Supplement 3 December 2011
78 pages
841 references

Supplement
Impact of postprandial glycaemia on health and prevention of disease

obesity reviews
doi: 10.1111/j.1467-768X.2012.01011.x

71 pages
464 references

Postprandial glycaemia

- Body Weight
- Appetite, satiety
- Etiology of IR, diabetes
- Cancer etiology
- CVD- ROS, TAGs, cholesterol
- Brain function, cognition,
- Physical performance

- Incretins: GLP-1, GIP
- Insulin
- Stress hormones
- Leptin , PYY, CCK,.. SCFA
BIG Portion sizes  
SOFT drink  
TV watching, Mindless eating!

http://www.ilsi.org/Europe/Pages/ConciseMonographSeries.aspx
Food

Stomach

Gastric emptying → Rate limiting factors

Small intestine

Disruption/digestion → Rate limiting factors

Free sugars → Portal circulation

Rate of glycemic carbohydrate availability determines the degree of glycemia/insulinemia/metabolism

Postprandial glucose, insulin, and incretin responses to grain products in healthy subjects

Katri S Juntunen, et al
Postprandial glucose, insulin, and incretin responses to grain products in healthy subjects
Katri S Juntunen, et al.

Dietary factors which influence Glycemic impact
1- Composition, 2 Quantity

4. Starch-nutrient interaction
   - Starch/fat
   - Starch/protein

5. Types and amounts of other nutrients
   - Proteins
   - Dietary fibers
   - Antinutrients
   - Organic acids

3. Food processing/cooking
   - Cooking time
   - Degree of starch gelatinisation
   - Particle size
   - Food form

2. Nature of starch
   - Amylose
   - Amylopectin
   - Slow digestible starches

1. Nature and quantity of the monosaccharides
   - Glucose
   - Galactose
   - Fructose
INCREMENTAL POSTPRANDIAL PLASMA GLUCOSE

<table>
<thead>
<tr>
<th></th>
<th>CHO</th>
<th>FIBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(g)</td>
<td>(g)</td>
</tr>
<tr>
<td>white bread</td>
<td>50</td>
<td>3.2</td>
</tr>
<tr>
<td>p. dumplings</td>
<td>50</td>
<td>1.2</td>
</tr>
<tr>
<td>pizza</td>
<td>50</td>
<td>3.2</td>
</tr>
<tr>
<td>hard toasted bread</td>
<td>50</td>
<td>3.2</td>
</tr>
</tbody>
</table>

R. Giacco et al Nutr rev 2003

Scanning Electron Microscopy

R. Giacco et al Nutr rev 2003
Glycemic load, cereal fiber intake and relative risk of type 2 diabetes in women

Salmeron J, et al. JAMA 1997; 472-477
Overby et al. 2012

- All 5 Nordic papers found protective associations between high intake of DF and health outcomes; CVD risk, type 2 diabetes, colorectal/breast cancer.

- No clear evidence for GI in prevention of risk factors or diseases in healthy populations, although association was found in overweight individuals, suggestive for type 2 diabetes prevention.

- Conclusion: DF $\rightarrow$ decreased risk of chronic disease.

- Not enough evidence that choosing foods with low GI will decrease the risk of chronic diseases in the population `at large.
Amount, type, and sources of carbohydrates in relation to ischemic heart disease mortality in a Chinese population: a prospective cohort study

Salome A Rebello, Hirumi Koh, Cynthia Chen, Nasheen Naidoo, Andrew O Odegaard, Woon-Puay Koh, Lesley M Butler, Jian-Min Yuan, and Rob M van Dam

• 53,469 participants in the Singapore Chinese Health Study: average follow-up of 15 y.
• Prospective examination of CHO intake \(\rightarrow\) IHD mortality using a semi-quantitative food-frequency questionnaire.


Results:
• 1660 IHD deaths during 804,433 person years follow-up.
• Total CHO intake was not associated with IHD mortality risk
• Types of CHO: starch intake \(\rightarrow\) higher IHD risk: men 1.03 women 1.08
• Fiber intake \(\rightarrow\) lower IHD risk: men 0.94 women 0.71

Substitution analyses:
• Replacing daily serving of rice with vegetables \(\rightarrow\) lower risk – 24%, fruit -11% or whole-wheat bread (- 19%).

What about sugar and fructose vs. starch?
Low GI/low GL is desired...

- Fructose: 15
- Sucrose: 65
- HFCS: 60
- Starch cooked: >90
Let's put things in perspective!

High intakes of pure fructose cause detrimental effects. However, we do not consume fructose in isolation. In combination with glucose, many pure fructose effects disappear. Thus: “fructose (in isolation) is a cause of obesity” is incorrect.

Consuming Fructose-sweetened Beverages Increases Body Adiposity in Mice.

- Ad libitum access to:
  - fructose
  - sucrose
  - artificial sweetener (0% calories, popular diet soft drink)

Study effects on adipogenesis and energy metabolism.

Hella Jurgens et al. OBESITY RESEARCH Vol. 13 No. 7 July 2005
Jürgens et al conclude that

- Fructose promotes adiposity
- The fructose-induced increase in fat mass is more likely based on the specific energy and sugar metabolism of dietary fructose.
- Fructose likely is one causal factor for the rapidly increasing number of obese patients.
- Is this a correct conclusion based on this data set…?

Fructose induces weight gain ONLY in pure fructose group and NOT in the sucrose group

- Ad libitum access to:
  - fructose (15% in water),
  - sucrose (10%, a soft drink),
The histological study shows increased fat in the liver of the (A) fructose group but NOT in (B) the soft drink group, (C) the diet soft drink group, and (D) the water control group (6 days).

Hella Jurgens et al., OBESITY RESEARCH Vol. 13 No. 7 July 2005

Adrian Cozma et, this conference:
- Hypercaloric fructose diets impair metabolic function likely more due to excess energy than fructose as such

Christine Tsilas et al., this conference
Consumption of fructose containing sugars was not associated with type 2 diabetes development in 7 prospective cohort studies

Ref GI tables Foster, Powel, 2008

Misconception:
fruit juices are high glycemic

<table>
<thead>
<tr>
<th>Food</th>
<th>As eaten, GI</th>
<th>Drink GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>Pineapple</td>
<td>51-66</td>
<td>46</td>
</tr>
<tr>
<td>Orange</td>
<td>31-51, mean 42</td>
<td>52 (46-71)</td>
</tr>
<tr>
<td>Soda’s</td>
<td>-</td>
<td>60(53-68)</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>46-49</td>
<td>48</td>
</tr>
</tbody>
</table>

Ref GI tables Foster, Powel, 2008
Effect of Fruit Juice on Glucose Control and Insulin Sensitivity in Adults: A Meta-Analysis of 12 Randomized Controlled Trials

Results:
• 12 studies: 412 subjects were included
• Fruit juice consumption did not show a significant effect on fasting glucose and insulin concentrations.

Consumption of 100% Fruit Juice: risk of Obesity and Metabolic Syndrome

National Health and Nutrition Examination Survey 1999-2004
Included 14,196 adults

Compared with non-consumers, 100% fruit juice consumers were:

- Leaner
- More insulin sensitive
- Had lower odds of obesity and metabolic syndrome.


Effects of DF on Glucose regulation

- Refined CHO
- Fermentable fibers
- Water-holding capacity → viscosity
- Post-prandial blood glucose levels (GI/GL of foods)
- Insulin secretion
- Insulin sensitivity
- Fasting blood glucose
- Important biomarkers to be controlled to reduce type 2 diabetes risks
Concerted actions required

Reduce postprandial glycemia by:
• food high in fiber (fruit, vegetable, whole grain)
• food with reduced rapid glucose (starch) availability (reduced cooking time, compact matrix)
• food low in added sugars
• reduce SSB: use waters, light, zero drinks
• use variety of foods assuring optimal micronutrient intake

Reduce overweight- diabetes-CVD risks further by:
• food low in TRANS- and SAT fats
• food high in MUFA-PUFA
• food low in added fat /sugar/salt
• Increasing daily physical activity
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Any questions?