A model for discriminating between carbohydrate-rich foods

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Change in risk of CHD death when replacing saturated fat with monos, polys and carbohydrate (5% en)

% change in hazard ratios for MI when replacing SAFA with low, medium and high GI carbohydrate (5% en)

- Low GI: -12% (ns)
- Medium GI: -2%
- High GI: 33%

Carbohydrates: new paradigm

- Some carbohydrates may be protective
- Some carbohydrates may increase risk
- There is a need to discriminate between carbohydrate-rich foods
What is ‘good’ carbohydrate?

- Sugars, complex carbohydrate?
- Low glycaemic index?
- High fibre?
- Wholegrain?
- High nutrient density?
Aim:
To develop a model for ranking the nutritional quality of carbohydrate-rich foods

- Nutrient density
- Glycaemic index
Aim:
To develop a model for ranking the nutritional quality of carbohydrate-rich foods

- Nutrient density
- Glycaemic index

“... the glycaemic index of foods be used in conjunction with information about food composition to guide food choices”

WHO 2003
Determining a nutrient density score:

1. Include nutrients with NRVs
2. Assess within food groups
3. Identify distinguishing nutrients of food groups
4. Develop an algorithm for nutrient density
5. Use a fixed amount of energy
6. Assess against recognised standards

Drewnowski A, Fulgoni V. Nutr Rev 2008
<table>
<thead>
<tr>
<th>Food group</th>
<th>Distinguishing nutrients</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Iron, fibre, folate, magnesium, vitamin B6, potassium</td>
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<td>Bread, cereal products</td>
<td>Thiamin, riboflavin, niacin, iron, fibre, folate</td>
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<td>Fruits</td>
<td>Vitamin C, folate, fibre, vitamin B6, potassium, vitamin E</td>
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<td>Starchy vegetables</td>
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Results
Carbohydrate quality quadrants

Glycaemic Index

Nutrient Density Score
Carbohydrate quality quadrants

Glycaemic Index

Nutrient Density Score

Higher nutrient density
Carbohydrate quality quadrants

Glycaemic Index vs Nutrient Density Score

Lower GI

Nutrient Density Score
Carbohydrate quality quadrants

Glycaemic Index

Highest quality

Lowest quality

Nutrient Density Score

Carbohydrate quality quadrants
Carbohydrate quality quadrants

Glycaemic Index

Nutrient Density Score

Second lowest quality

Highest quality

Second highest quality

Lowest quality
Legumes
Legumes

Glycaemic Index

Nutrient Density Score

- Soya beans, boiled
- Soya beans, canned
- Red kidney beans, boiled
- Lentils
- Split peas
- Haricot beans
- Chickpeas, canned
- Baked beans, canned
- Red kidney beans, canned
- Split peas
- Haricot beans
- Red kidney beans, boiled
Soft drinks, confectionery, condiments
Soft drinks, confectionery and condiments

Glycaemic Index

Nutrient Density Score

- Jam, strawberry
- Soft drink, cola
- Mars Bar
- Sweets, peppermints
- Honey
- Sweets, jelly beans
Dairy products
Starchy vegetables
Starchy vegetables

Glycaemic Index

Nutrient Density Score

Carrot (80)
Peas (71)
Sweet corn
Sweet potato
Parsnip
Pumpkin
Potato, boiled
Fruits
Fruits without vitamin C (5-nutrient score)

Glycaemic Index

Nutrient Density Score

- Banana
- Rockmelon
- Dried apricots
- Orange
- Mango
- Grapes
- Watermelon
- Nectarine
- Apple
- Peach
- Sultanas
- Apple juice
- Pear
- Cordial (40% juice)
- Orange juice
- Rockmelon
‘Non-core’ cereal foods
Biscuits, cakes, pastries
‘Non-core’ cereal foods – biscuits, cakes, pastries
‘Core’ cereal foods
Grains, breads, breakfast cereals
‘Core’ cereal foods – grains, breads, breakfast cereals

Glycaemic Index

Nutrient Density Score

- Pasta, white
- Pasta, wholemeal
- Rolled oats
- Bread, white
- Bread, wholemeal
- Bread, sourdough, white
- Bread, multigrain
- Sustain
- Nutrigrain
- WeetBix
- Nutri-grain
- Cornflakes
- Rice Bubbles
- Sultana Bran
- Just Right
- Bread, ‘Soy-Lin’
- All Bran
- Semolina
- Couscous
- Polenta
- Vitabrits
- muesli, toasted
- Pasta, white
- Brown rice
- White rice
- Polenta
- Couscous
- Bread, ‘Soy-Lin’
- All Bran
- Nutri-grain
- WeetBix
- Cornflakes
- Rice Bubbles
- Sultana Bran
- Just Right
- Bread, ‘Soy-Lin’
- All Bran
- Semolina
- Couscous
- Polenta
- Vitabrits
- muesli, toasted
- Pasta, white
- Brown rice
- White rice
- Polenta
- Couscous
‘Core’ cereal foods – refined/not enriched

Glycaemic Index

Nutrient Density Score

- Pasta, white
- Semolina
- Couscous
- Polenta
- White rice
‘Core’ cereal foods – refined/not enriched vs ‘non-core’ cereals

Glycaemic Index vs Nutrient Density Score

- White rice
- Pasta, white
- Semolina
- Polenta
- Couscous
- ‘Core’ cereal foods – refined/not enriched
- Sponge cake
- Cake, banana
- Cake, banana
- Pasta, white
- Semolina
- Biscuit, oatmeal
- Biscuit, shortbread
- Croissant
- Couscous
- Polenta
- Biscuit, flaky cracker
- Biscuit, cracker
- Donut
- Biscuit, cracker
- Biscuit, plain, sweet
- Biscuit, cracker
- Biscuit, flaky cracker
- Donut
- Biscuit, cracker
- Biscuit, plain, sweet
- Biscuit, shortbread
- Croissant
- Couscous
- Polenta
- Biscuit, flaky cracker
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- Biscuit, cracker
- Biscuit, plain, sweet
- Biscuit, shortbread
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- Biscuit, flaky cracker
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- Biscuit, cracker
- Biscuit, plain, sweet
- Biscuit, shortbread
- Croissant
- Couscous
- Polenta
- Biscuit, flaky cracker
- Biscuit, cracker
- Donut
- Biscuit, cracker
- Biscuit, plain, sweet
‘Core’ cereal foods – enriched

Glycaemic Index

Nutrient Density Score

- Bread, ‘Soy-Lin’
- Bread, sourdough, white
- Bread, multigrain
- Bread, white
- Bread, wholemeal
- Just Right
- Sultana Bran
- Sustain
- Special K
- Nutrigrain
- WeetBix
- Nutritein
- Cornflakes
- Rice Bubbles
- All Bran
‘Core’ cereal foods – white vs wholegrain

- Bread, white
- Bread, wholemeal
- Pasta, white
- Pasta, wholemeal
- White rice
- Brown rice

Nutrient Density Score vs Glycaemic Index graph
Sugar and nutrient dilution
Dairy products

Nutrient dilution by sugar

Glycaemic Index

Nutrient Density Score

Milk, full fat
Milk, flavoured
Yoghurt, natural
Yoghurt, low fat, sweetened
Milk, red. fat
Milk, skim
Yoghurt, low fat, natural
‘Core’ cereal foods – refined/not enriched

- Pasta, white
- Semolina
- Couscous
- Polenta
- White rice
‘Core’ cereal foods – refined/not enriched vs ‘non-core’ cereals

Glycaemic Index

Nutrient Density Score

White rice
Pasta, white
Semolina
Polenta
Couscous – refined/not enriched vs ‘non-core’ cereals

Sponge cake
Cake, banana
Pasta, white
Semolina

Biscuit, oatmeal

Biscuit, shortbread

Biscuit, flaky cracker

Donut

Biscuit, cracker

White rice
Biscuit, plain, sweet
‘Core’ cereal foods – breakfast cereals

Glycaemic Index

Nutrient Density Score

- Rolled oats
- Vitabrits
- muesli, toasted
- Sultana Bran
- Just Right
- Sustain
- Nutrigrain
- WeetBix
- Cornflakes
- All Bran
- Rice Bubbles

‘Core’ cereal foods include breakfast cereals, muesli, toasted oats, and other high-fiber options.
Sugar and nutrient density

“Observed negative associations between added sugar intake and micronutrient density of the diet are mainly related to patterns of intake of the foods from which added sugars in the diet are derived rather than to intake of added sugars per se.”

European Food Safety Authority (2010)
Food patterns, sugar and nutrient density

Glycemic Index

Nutrient Density Score

- Flavoured milk, fruit yoghurt
- Enriched breakfast cereals
Food patterns, sugar and nutrient density

Glycemic Index vs Nutrient Density Score

- Soft drink, confectionery
- Biscuits, cakes, pastries
- Flavoured milk, fruit yoghurt
- Enriched breakfast cereals
‘No added sugar’ – potential for adverse effects

- Apple juice
- Milk, flavoured
Sugar in breakfast cereals

- 10 vitamins and minerals
- 50% wholegrain
Sugar in breakfast cereals

- 10 vitamins and minerals
- 50% wholegrain
- 27% sugar!!
Final word

- If nutrient dilution is the concern, make nutrient density a criterion on which carbohydrate-rich foods are judged

- Science or dogma?