Gene Polymorphisms and dietary preferences

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Genetic polymorphism of the adenosine A\textsubscript{2A} receptor is associated with habitual caffeine consumption\textsuperscript{1–3}

Marilyn C Cornelis, Ahmed El-Soehemy, and Hannia Campos

CHAPTER 12

The Genetic Determinants of Ingestive Behavior: Sensory, Energy Homeostasis and Food Reward Aspects of Ingestive Behavior

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OUTLINE

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Eny and El-Sohemy, 2010
Glucose Transporter Type-2 (GLUT2)

Brain

Liver

Kidney

Pancreas

Small Intestine

Glucose Homeostasis

Thr 110 Ile

GLUT2 Protein
Study Population

- 109 men and women (36-75 years)
- Overweight/obese with mild type 2 diabetes
- Diet: 3-day food records (repeated 2 weeks later)
Sugar

Visit 1
- Thr/Thr: 86 g
- Thr/Ile + Ile/Ile: 112 g

Visit 2
- Thr/Thr: 82 g
- Thr/Ile + Ile/Ile: 111 g

P = 0.01
P = 0.003

Protein

Visit 1

Genotype

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Protein (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thr/Thr</td>
<td>91 g</td>
</tr>
<tr>
<td>Thr/Ile + Ile/Ile</td>
<td>95 g</td>
</tr>
</tbody>
</table>

Visit 2

Genotype

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Protein (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thr/Thr</td>
<td>92 g</td>
</tr>
<tr>
<td>Thr/Ile + Ile/Ile</td>
<td>93 g</td>
</tr>
</tbody>
</table>

P = 0.46

P = 0.87

Replication Study

• Population 1
  – 109 men and women (36-75 years)
  – Overweight/obese with mild type 2 diabetes
  – Diet: 3-day food records (repeated 2 weeks later)

• Population 2
  – 954 young men and women (20-29 years)
    (Toronto Nutrigenomics and Health Study)
  – Mostly lean and healthy
  – Diet: Food Frequency Questionnaire
Sugar

Sugars (g/d)

Genotype

Thr/Thr

Thr/Ile + Ile/Ile

115 g

131 g

P = 0.007

Protein and Fat

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Protein (g/d)</th>
<th>Fat (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thr/Thr</td>
<td>86 g</td>
<td>66 g</td>
</tr>
<tr>
<td>Thr/Ile + Ile/Ile</td>
<td>85 g</td>
<td>70 g</td>
</tr>
</tbody>
</table>

P = 0.92

P = 0.15

Genetic variant in the glucose transporter type 2 is associated with higher intakes of sugars in two distinct populations

Karen M. Eny, Thomas M. S. Wolever, Bénédicte Fontaine-Bisson, and Ahmed El-Sohemy

Department of Nutritional Sciences, University of Toronto; and St. Michael’s Hospital, Toronto, Canada

Submitted 10 July 2007; accepted in final form 14 March 2008

GLUT2

- Sensory Perception
- Energy Homeostasis
- Food Reward Circuits

Energy Expenditure

Food Intake

Obesity Risk

Eny and El-Sohemy, 2010
Dopamine D2 Receptor Genotype (C957T) and Habitual Consumption of Sugars in a Free-Living Population of Men and Women

Karen M. Eny\textsuperscript{a}  Paul N. Corey\textsuperscript{b}  Ahmed El-Sohemy\textsuperscript{a}

\textsuperscript{a}Department of Nutritional Sciences and \textsuperscript{b}Dalla Lana School of Public Health, University of Toronto, Toronto, Ont., Canada
Table 3. Macronutrient intake by DRD2 genotypes in men

<table>
<thead>
<tr>
<th></th>
<th>CC (n = 19)</th>
<th>CT (n = 50)</th>
<th>TT (n = 27)</th>
<th>Unbiased ANCOVA p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories, kcal/day</td>
<td>2,242 ± 159</td>
<td>2,150 ± 101</td>
<td>1,988 ± 141</td>
<td>0.44</td>
</tr>
<tr>
<td>Protein, g/day</td>
<td>86 ± 9</td>
<td>89 ± 5</td>
<td>83 ± 8</td>
<td>0.71</td>
</tr>
<tr>
<td>Fat, g/day</td>
<td>71 ± 7</td>
<td>71 ± 4</td>
<td>69 ± 6</td>
<td>0.94</td>
</tr>
<tr>
<td>Total carbohydrate, g/day</td>
<td>304 ± 22</td>
<td>285 ± 14</td>
<td>258 ± 20</td>
<td>0.26</td>
</tr>
<tr>
<td>Fiber, g/day</td>
<td>22 ± 3</td>
<td>24 ± 2</td>
<td>24 ± 3</td>
<td>0.72</td>
</tr>
<tr>
<td>Available carbohydrate, g/day</td>
<td>282 ± 20</td>
<td>261 ± 13</td>
<td>234 ± 18</td>
<td>0.19</td>
</tr>
<tr>
<td>Starch, g/day</td>
<td>135 ± 11</td>
<td>135 ± 7</td>
<td>123 ± 10</td>
<td>0.53</td>
</tr>
<tr>
<td>Sugars, g/day</td>
<td>147 ± 13</td>
<td>126 ± 8</td>
<td>111 ± 12</td>
<td>0.11</td>
</tr>
<tr>
<td>Sucrose, g/day</td>
<td>60 ± 6(^a)</td>
<td>48 ± 4(^a, b)</td>
<td>39 ± 5(^b)</td>
<td>0.03</td>
</tr>
<tr>
<td>Lactose, g/day</td>
<td>20 ± 3</td>
<td>18 ± 2</td>
<td>16 ± 3</td>
<td>0.46</td>
</tr>
<tr>
<td>Maltose, g/day</td>
<td>2.8 ± 0.3</td>
<td>2.7 ± 0.2</td>
<td>2.6 ± 0.3</td>
<td>0.87</td>
</tr>
<tr>
<td>Fructose, g/day</td>
<td>33 ± 4</td>
<td>29 ± 3</td>
<td>28 ± 3</td>
<td>0.69</td>
</tr>
<tr>
<td>Glucose, g/day</td>
<td>30 ± 3</td>
<td>28 ± 2</td>
<td>26 ± 3</td>
<td>0.51</td>
</tr>
<tr>
<td>Cholesterol, mg/day</td>
<td>278 ± 39</td>
<td>262 ± 25</td>
<td>244 ± 34</td>
<td>0.50</td>
</tr>
<tr>
<td>Alcohol, g/day</td>
<td>14 ± 3</td>
<td>10 ± 2</td>
<td>11 ± 2</td>
<td>0.93</td>
</tr>
<tr>
<td>Nutrient</td>
<td>CC (n = 47)</td>
<td>CT (n = 124)</td>
<td>TT (n = 46)</td>
<td>Unbiased ANCOVA p value</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------</td>
<td>--------------</td>
<td>-------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Calories, kcal/day</td>
<td>1,889 ± 83</td>
<td>2,065 ± 53</td>
<td>1,954 ± 84</td>
<td>0.14</td>
</tr>
<tr>
<td>Protein, g/day</td>
<td>79 ± 4</td>
<td>83 ± 3</td>
<td>81 ± 4</td>
<td>0.66</td>
</tr>
<tr>
<td>Fat, g/day</td>
<td>64 ± 4</td>
<td>70 ± 2</td>
<td>67 ± 4</td>
<td>0.35</td>
</tr>
<tr>
<td>Total carbohydrate, g/day</td>
<td>245 ± 13</td>
<td>275 ± 8</td>
<td>256 ± 13</td>
<td>0.10</td>
</tr>
<tr>
<td>Fiber, g/day</td>
<td>24 ± 2</td>
<td>26 ± 1</td>
<td>26 ± 2</td>
<td>0.49</td>
</tr>
<tr>
<td>Available carbohydrate, g/day</td>
<td>222 ± 12</td>
<td>249 ± 8</td>
<td>230 ± 12</td>
<td>0.09</td>
</tr>
<tr>
<td>Starch, g/day</td>
<td>112 ± 6</td>
<td>115 ± 4</td>
<td>110 ± 6</td>
<td>0.80</td>
</tr>
<tr>
<td>Sugars, g/day</td>
<td>110 ± 8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>134 ± 5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>120 ± 8&lt;sup&gt;a&lt;/sup&gt;&lt;sub&gt;,&lt;/sub&gt;&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.02</td>
</tr>
<tr>
<td>Sucrose, g/day</td>
<td>42 ± 4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53 ± 2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>44 ± 4&lt;sup&gt;a&lt;/sup&gt;&lt;sub&gt;,&lt;/sub&gt;&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.01</td>
</tr>
<tr>
<td>Lactose, g/day</td>
<td>18 ± 2</td>
<td>21 ± 1</td>
<td>19 ± 2</td>
<td>0.42</td>
</tr>
<tr>
<td>Maltose, g/day</td>
<td>2.0 ± 0.2</td>
<td>2.2 ± 0.1</td>
<td>2.2 ± 0.2</td>
<td>0.41</td>
</tr>
<tr>
<td>Fructose, g/day</td>
<td>25 ± 2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30 ± 1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>28 ± 2&lt;sup&gt;a&lt;/sup&gt;&lt;sub&gt;,&lt;/sub&gt;&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.04</td>
</tr>
<tr>
<td>Glucose, g/day</td>
<td>23 ± 2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28 ± 1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>27 ± 2&lt;sup&gt;a&lt;/sup&gt;&lt;sub&gt;,&lt;/sub&gt;&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.07</td>
</tr>
<tr>
<td>Cholesterol, mg/day</td>
<td>228 ± 16</td>
<td>223 ± 10</td>
<td>214 ± 16</td>
<td>0.80</td>
</tr>
<tr>
<td>Alcohol, g/day</td>
<td>7 ± 1</td>
<td>7 ± 1</td>
<td>5 ± 1</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Genetic variation in TAS1R2 (Ile191Val) is associated with consumption of sugars in overweight and obese individuals in 2 distinct populations\textsuperscript{1–3}

Karen M Eny, Thomas MS Wolever, Paul N Corey, and Ahmed El-Sohemy


Carriers of the Val allele consume less sugar.
Genetic variation in *TAS1R2* (Ile191Val) is associated with consumption of sugars in overweight and obese individuals in 2 distinct populations\(^1-3\)

Karen M Eny, Thomas MS Wolever, Paul N Corey, and Ahmed El-Sohemy


### TABLE 8
Diet changes between food records 1 and 2 by Ile191Val genotype in population 2\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>Ile/Ile (n = 47)</th>
<th>Val carriers (n = 53)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SEM</td>
<td>(P)</td>
</tr>
<tr>
<td>Energy (kcal/d)</td>
<td>41.73 ± 55.20</td>
<td>0.45</td>
</tr>
<tr>
<td>Protein (g/d)</td>
<td>3.56 ± 3.34</td>
<td>0.29</td>
</tr>
<tr>
<td>Fat (g/d)</td>
<td>0.65 ± 3.36</td>
<td>0.85</td>
</tr>
<tr>
<td>Total carbohydrates (g/d)</td>
<td>3.63 ± 7.63</td>
<td>0.64</td>
</tr>
<tr>
<td>Fiber</td>
<td>1.63 ± 0.91</td>
<td>0.08</td>
</tr>
<tr>
<td>Available carbohydrates</td>
<td>-1.35 ± 4.30</td>
<td>0.75</td>
</tr>
<tr>
<td>Starch</td>
<td>2.00 ± 7.20</td>
<td>0.78</td>
</tr>
<tr>
<td><strong>Sugars</strong></td>
<td><strong>3.35 ± 5.21</strong></td>
<td><strong>0.52</strong></td>
</tr>
<tr>
<td>Cholesterol (mg/d)</td>
<td>23.27 ± 23.71</td>
<td>0.33</td>
</tr>
<tr>
<td>Alcohol (g/d)</td>
<td>1.59 ± 1.22</td>
<td>0.20</td>
</tr>
</tbody>
</table>

\(^1\) All values are mean ± SEM changes. Paired \(t\) tests were used to measure the within-person change in nutrient consumption that occurred between food records 1 and 2. Population 2 consisted of older men and women with type 2 diabetes.
Sensory Evaluation

Subjects
- N = 118
- Caucasian, Age 20-33, Non Smokers

Solutions
- NaCl, Sucrose, Citric Acid, PROP, FAs

Visit 1- Threshold Testing
Method: 3 Alternative Forced Choice Staircase

Visit 2-Supra-threshold Testing
Method: Scaling with the general Limited Magnitude Scale
Affymetrix 6.0 chip

- 906,000 SNPs
- 946,000 Copy Number Variation probes

Subjects

- n=550
- Caucasian
Implications

Diet

Genotype

Health Outcome (+/-)
ACKNOWLEDGMENTS

Karen Eny
Marilyn Cornelis
Bénédicte Fontaine-Bisson
Ilana Platt
Stephen Ozsungur
Leah Cahill
Clare Toguri
Hyeon-Joo Lee
Lindsay Stewart
Daiva Nielsen
Alejandra Navarro-Allende
Susana Huang
Sarah Herd
Darren Brenner
Bibiana Garcia-Bailo
Tom Wolever
Lisa Duizer
Paul Corey
Hannia Campos
David Jenkins

Advanced Foods and Materials Network Centres of Excellence

Natural Sciences and Engineering Research Council

Canadian Institutes of Health Research

Canadian Diabetes Association

Canada Research Chairs