White Rice, Brown Rice, and Risk of Type 2 Diabetes in US Men and Women

Qi Sun, Donna Spiegelman, Rob M. van Dam, Michelle D. Holmes, Vasanti S. Malik, Walter C. Willett, and Frank B. Hu

Harvard School of Public Health
Channing Laboratory, Harvard Medical School

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Rice

- Rice is a staple food for various populations.
  - Refined white rice vs. whole-grain brown rice.
In US, rice consumption increased dramatically nationwide. The majority (70%) is white rice. Prospective data are sparse regarding the association between rice consumption and diabetes risk in U.S. populations. In a Chinese population, white rice consumption was associated with increased risk of type 2 diabetes. (Villegas et al, Archives of Internal Medicine, 2007)

Objective

- To examine both white rice and brown rice consumption in relation to type 2 diabetes in U.S. men and women.
- To examine whether replacing white rice with brown rice or other whole-grains is associated with the risk of type 2 diabetes.
Study Populations

**Nurses’ Health Study (NHS)** (n=121,700; age 37-65)

- Blood Collection
- Diet
- Lifestyle/Disease
- Start

**Health Professionals Follow-up Study (HPFS)** (n=51,529; age 32-87)

Follow-up

Slide courtesy of Dr. Yi Ning
Study Populations (cont)

Nurses’ Health Study II (NHS II) (n=116,686; age 26-45)

Blood Collection
Diet
Lifestyle/Disease
Start

Follow-up

91 95 99 03 05

Slide courtesy of Dr. Yi Ning
Food frequency questionnaire

- Rice consumption
  - White/brown rice (1 cup cooked)
  - Never or less than once/month to 6+ per day
  - White rice
    - <1 serving/month, 1-3 servings/month, 1 serving/week, 2-4 servings/week, and ≥5 servings/week
  - Brown rice
    - <1 serving/month, 1-4 servings/month, and ≥2 servings/week

- Validity
  - White rice: 0.53
  - Brown rice: 0.41

Exclusions

- Existing common diseases at baseline
  - Diabetes, CVD, common cancers
- Poor FFQ response
- Missing white rice, brown rice, or whole grain consumption data
  - HPFS: 39,765 participants; 1986-2006
  - NHS I: 69,120 participants; 1984-2006
  - NHS II: 88,343 participants; 1991-2005
Outcome

- Type 2 diabetes
  - Self-reports confirmed by using a validated supplementary questionnaire
Statistical analysis

- Cox regression
  - Cumulative average of rice consumption
  - Stop updating diet after subjects developed chronic diseases that may alter usual diet to minimize time-varying confounding
  - Adjusted for age, BMI, and other lifestyle and dietary risk factors of diabetes
  - Fixed-effects model used to pool estimates from three studies
Results
Results: white rice consumption levels
Results: brown rice consumption levels
Confounders

- **White rice**
  - ↑ European ancestry, smoking, family history of diabetes, and fruit and vegetable intake
  - ↓ whole grains, cereal fiber, and trans fat

- **Brown rice**
  - ↑ physically active, fruits, vegetables, and whole grains
  - ↓ BMI, smoking, family history of diabetes, and intake of red meat and trans fat.
Results: white rice

Rate ratio (95% CI) of type 2 diabetes

White rice consumption
Results: brown rice

Rate ratio (95% CI) of type 2 diabetes

Brown rice consumption

<1/mo  1-4/mo  ≥2/wk

HPFS  NHS I  NHS II  Pooled
Results: whole-grains

Rate ratio (95% CI) of type 2 diabetes

Whole-grain intake

Quintile 1  Quintile 2  Quintile 3  Quintile 4  Quintile 5

HPFS  NHS I  NHS II  Pooled
Results: substituting 50 gram/day brown rice for white rice

<table>
<thead>
<tr>
<th>Study</th>
<th>Relative Risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPFS</td>
<td>0.93 (0.83, 1.05)</td>
</tr>
<tr>
<td>NHS I</td>
<td>0.75 (0.66, 0.85)</td>
</tr>
<tr>
<td>NHS II</td>
<td>0.85 (0.75, 0.97)</td>
</tr>
</tbody>
</table>

Overall
(I-squared = 66.2%, $P = 0.052$)

0.84 (0.79, 0.91)
Results: substituting 50 gram/day whole grains for white rice

<table>
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<tr>
<th>Study</th>
<th>Relative Risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPFS</td>
<td>0.74 (0.64, 0.86)</td>
</tr>
<tr>
<td>NHS I</td>
<td>0.51 (0.44, 0.60)</td>
</tr>
<tr>
<td>NHS II</td>
<td>0.70 (0.58, 0.85)</td>
</tr>
<tr>
<td>Overall (I-squared = 84.2%, P = 0.002)</td>
<td>0.64 (0.58, 0.70)</td>
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Sensitivity analyses

- Restricted to white participants
- Restricted to minorities
- More recent diet
Strengths and Limitations

- **Limitations**
  - Generalizability: white health professionals
  - Low intake levels
  - Measurement error of FFQ assessments
  - Residual confounding

- **Strengths**
  - Large sample size
  - High follow-up rate
  - Multiple confounders
  - Repeated assessments of diet
Conclusions

- Regular consumption of white rice is associated with an increased risk of T2D, whereas replacement of white rice by brown rice or other whole grains is associated with a lower risk.
- From a public health point of view, replacing refined grains such as white rice by whole grains, including brown rice, should be recommended to facilitate the prevention of type 2 diabetes.
Thank You!