China Rural Health Initiative – Sodium Reduction Study: the effects of a community-based sodium reduction program on 24hr urinary sodium and blood pressure in rural China

Dr Nicole Li
18th November 2013
Cardiovascular diseases are the leading cause of death in China, responsible for more than 3 million deaths each year.

Stroke, high blood pressure and excess salt consumption (12-15g/day) highly prevalent in rural China

Little debate about the adverse effects of salt consumption at this level, or the potential benefits of salt restriction
Objective

To define the effects of a novel, low-cost, scalable and sustainable, community-based salt reduction strategy on salt consumption, as estimated from 24-hour urinary sodium excretion
Design

120 villages

60 villages in intervention group
Randomized

30 villages without price subsidy

30 villages with price subsidy

60 villages in control group
Intervention and control

■ Intervention

■ Health education
  ▪ Health belief model
    ■ Awareness
    ■ Beliefs
    ■ Behavior
  ▪ Key messages
  ▪ Implementation Strategy

■ Access to salt substitute
  ▪ Salt Substitute
    ■ 65-75% NaCl
    ■ 15-25% KCl
    ■ 0-10% MgSO4
  ▪ Double cost of usual salt
  ▪ Promotion of sales

■ Control: usual practice
Outcomes

- **Primary**
  - 24h urinary sodium (90% power, 11mmol/day difference)

- **Secondary**
  - 24-hour urinary potassium
  - Na/K ratio
  - Knowledge, attitude and practices
  - Systolic and diastolic blood pressure
  - Proportion with hypertension

- Questionnaire, examination and 24hr urine collection
Analysis

- Intention to treat, no imputation for missing value
- GEE model accounting for cluster effects
- Primary comparison of 60 intervention vs. 60 control villages
- Secondary comparison of 30 price subsidy vs. 30 no price subsidy villages
- Pre-defined subgroups – age, sex, education, BMI, smoking, alcohol
Survey data

- 60 intervention villages
  - 1,295 questionnaire and examination
  - 1,063 urine sample (82%)

- 59 control villages
  - 1,272 questionnaire and examination
  - 1,001 urine sample (77%)
Characteristics of survey participants

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (%)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Age (years)</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Current smoker (%)</td>
<td>33</td>
<td>30</td>
</tr>
<tr>
<td>Drinks alcohol (%)</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Education &gt;9 years (%)</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>56</td>
<td>58</td>
</tr>
</tbody>
</table>
Effects on 24hr urinary sodium and potassium

- Sodium: Intervention group saw a decrease of 230 mmol (4 to 10, p<0.001) compared to the control group.
- Potassium: Intervention group saw an increase of 51 mmol (-26 to -1, p=0.03) compared to the control group.
- Na/K ratio: Intervention group saw a decrease of 0.9 (-1.2 to -0.5, p<0.001) compared to the control group.
Effects on blood pressure outcomes

- Systolic blood pressure
  -1.0mmHg (-3.2 to 1.2), p=0.39

- Diastolic blood pressure
  -0.8mmHg (-2.3 to 0.8), p=0.34

- Percent with hypertension
  -2.2% (-5.5 to 1.2), p=0.20
Effects on knowledge and behaviors

- Know salt is harmful
- Know daily limit is <6g/day
- Know reducing salt lowers BP
- Concerned about salt in diet
- Household uses salt substitute

Comparison of Intervention and Control groups:
- 60 Intervention
- 59 Control
- 30 Subsidy
- 30 No Subsidy

Bar charts showing differences in knowledge and behaviors between groups.
Interpretation

- 1.0g lower salt intake delivers:
  - 1.8%-2.8% reduced risk of stroke
- 13mmol sodium reduction (0.75g Salt reduction):
  - 1.4%-2.1% reduced risk of stroke
  - 1.4%-2.1% reduction of 2 million new stroke cases ≈ 28,000-42,000 strokes prevented each year in China
  - Additional effects of potassium supplementation not included.

K. Bibbins-Domingo et al.. N Engl J Med. 20 Jan, 2010
Discussion

- **Strengths**
  - Robust large scale randomized design
  - Excellent statistical power for primary outcome
  - Gold standard 24 hour urine collections
  - Simple, low-cost, scalable intervention

- **Weakness**
  - Limited power for secondary blood pressure and hypertension outcomes
Conclusions

- Anticipated effects on sodium excretion were achieved.
- Effects appear to have been driven primarily by use of the salt substitute (through provision of education and access).
- Subsidization of the price of salt substitute was important for uptake.
- Salt substitution has significant potential to reduce the large burden of blood-pressure related disease in rural China.
Acknowledgement

**Sponsors**
- The US NIH NHLBI
- The US CDC DHDSP
- United Health Group

**Partners**
- US CDC
- The Duke University
- The George Institute for Global Health, Australia
- Peking University Health Science Center
- China Medical University
- Jiaotong University Medical College
- Hebei Provincial CDC
- Ningxia Medical University
- Changzhi Medical University