Salt substitution and community-wide reductions in blood pressure and hypertension incidence

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Declaration of interest

- I have nothing to declare
Conflicts of interests @jjaimemiranda

- This study
  - Funded by NHLBI-NIH
  - Global Alliance for Chronic Diseases (GACD) programme
  - NCT01960972
- Me
  - AHPSR/WHO, CONCYTEC, GCC, IDRC, MRC, NIH, SNF, Wellcome, WDF
- No pharma funding
Hypertension a global health issue

– Individuals, households, communities and societies
– Health systems
  • chronic care
  • human resources
  • task-shifting
Not enough cardiologists

- **Forecasting imbalances** in the global health labor market and devising policy responses
- **The Supply and Demand of the Cardiovascular Workforce**: Striking the Right Balance
- **Urgent need** for human resources to promote global cardiovascular health
- **Trends and contexts in European cardiology practice** for the next 15 years: the Madrid Declaration
- **Too many patients, too few cardiologists** to care?
“The corresponding strategies in control are the ‘high-risk’ approach, which seeks to protect susceptible individuals, and the population approach, which seeks to control the causes of incidence […] not usually in competition, but the prior concern should always be to discover and control the causes of incidence.”
The most important public health question

“‘Why is hypertension absent in the Kenyans and common in London?’.

The answer to that question has to do with the determinants of the population mean; for what distinguishes the two groups is nothing to do with the characteristics of individuals, it is rather a shift of the whole distribution—a mass influence acting on the population as a whole.”

Blood pressure matters

“Even a 2 mm Hg lower usual SBP would involve about 10% lower stroke mortality and about 7% lower mortality from IHD or other vascular causes in middle age.”

“So, for the general normotensive population, producing persistent reductions in average blood pressure of just a few mm Hg by some widely practicable methods [...] should avoid large absolute numbers of premature deaths and disabling strokes.”

Salt and BP
↓sodium ↑potassium

Effects of salt substitutes on blood pressure: a meta-analysis of randomized controlled trials.
Peng YG\textsuperscript{1,}, Li W\textsuperscript{1}, Wen XX\textsuperscript{1}, Li Y\textsuperscript{1}, Hu JH\textsuperscript{1}, Zhao LC\textsuperscript{1}.

Effect of low-sodium salt substitutes on blood pressure, detected hypertension, stroke and mortality.
Hernandez AV\textsuperscript{1,2}, Emonds EE\textsuperscript{1}, Chen BA\textsuperscript{1}, Zavala-Loayza AJ\textsuperscript{3}, Tholo P\textsuperscript{4}, Persugoloti V\textsuperscript{5}, Roman YM\textsuperscript{1}, Bernabe-Ortiz A\textsuperscript{3,6}, Miranda JJ\textsuperscript{3}.

Potassium supplementation for the management of primary hypertension in adults.
Dickinson HO, Nicholson DJ, Campbell F, Beyer FR, Mason J.
Telling people to reduce salt...

- Aim: To assess the long term effects of advice to restrict dietary sodium in adults with and without hypertension.
- Conclusion: Intensive interventions, unsuited to primary care or population prevention programmes, provide only small reductions in blood pressure and sodium excretion, and effects on deaths and cardiovascular events are unclear.
- 2014 Cochrane review update: conclusions unchanged

Launching a salt substitute to reduce blood pressure at the population level: a cluster randomized stepped wedge trial in Peru

Antonio Bernabe-Ortiz¹,², Francisco Diez-Canseco¹, Robert H Gilman³,⁴, María K Cárdenas¹, Katherine A Sacksteder³ and J Jaime Miranda¹,⁵*
Study objective and design

• To assess the efficacy of a pragmatic intervention using a salt substitution strategy to reduce blood pressure, as well as its impact on the incidence of hypertension, at the population level using a stepped wedge cluster trial in Peru.
Tumbes, Peru

Department: Tumbes

Population: ~200,000

Poverty level: ~25.0%

Hypertension: 27% (≥35 years, in 2010)
Regular salt, 100% NaCl
Participants

• All adults ≥18yo
  – 2376/2605 (91.2%) enrolled
• 6 semi-rural villages
  – Agriculture or fishing
• Excluded
  – chronic kidney disease
  – heart disease, digoxin tx
Intervention

• To guarantee the full replacement of salt in the entire village

  – What?  Salt substitute
  – How?  Free of charge but in exchange of regular salt (*)
  – Where?  Households, small shops, bakeries and community kitchens, food vendors including street vendors and restaurants.

(*) 1 Kg of regular salt ~US$ 0.20-0.30
Outcomes

Primary
• Systolic blood pressure (SBP)
• Diastolic blood pressure (DBP)
  – BP measured every 5 months
  – 7 rounds of measurements

Secondary
• Incidence of hypertension
  – SBP ≥140 mm Hg or DBP ≥90 mm Hg
• Changes in levels of sodium and potassium excretion in 24-hour urine.
  – random sub-sample of participants
• SBP and DBP
  – by HT status
  – by age groups
Formative Research

• Identify optimal flavor
  – Triangle taste test
  – 75% NaCl & 25% KCl

• Identify target audience
  – Interviews + focus groups
  – Women & community

• Develop product identity
  – Short questionnaire
  – 60 participants, 10 per village
Product Identity

- **Name**: Liz
- **Character**: Local women
- **Packaging**: Transparent plastic bags, red and orange colors, including product information, 1 Kg
- **Salt container**: Plastic, screw cap, 1 Kg. capacity
Product | Salt Liz
Price | Exchange
Place | Door-to-door + network
Promotion | Campaign

4Ps
Social Marketing Campaign
# Table 1: Baseline characteristics

<table>
<thead>
<tr>
<th>Sex</th>
<th>Baseline (N=2376)</th>
<th>Time in (person-years)</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1197 (50.4%)</td>
<td>1335.2</td>
<td>1768.4</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1179 (49.6%)</td>
<td>1212.0</td>
<td>1836.9</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29 years</td>
<td>633 (26.6%)</td>
<td>595.6</td>
<td>703.0</td>
<td></td>
</tr>
<tr>
<td>30-44 years</td>
<td>760 (32.6%)</td>
<td>800.2</td>
<td>1226.9</td>
<td></td>
</tr>
<tr>
<td>45-64 years</td>
<td>656 (27.6%)</td>
<td>715.3</td>
<td>1129.2</td>
<td></td>
</tr>
<tr>
<td>≥65 years</td>
<td>307 (12.9%)</td>
<td>356.1</td>
<td>546.3</td>
<td></td>
</tr>
<tr>
<td>Wealth Index</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td>689 (29.6%)</td>
<td>629.4</td>
<td>1137.8</td>
<td></td>
</tr>
<tr>
<td>Middle</td>
<td>785 (33.7%)</td>
<td>866.5</td>
<td>1180.6</td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td>855 (36.7%)</td>
<td>1001.1</td>
<td>1232.5</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;7 years</td>
<td>836 (35.2%)</td>
<td>909.0</td>
<td>1281.0</td>
<td></td>
</tr>
<tr>
<td>7-11 years</td>
<td>1090 (45.9%)</td>
<td>1185.3</td>
<td>1636.6</td>
<td></td>
</tr>
<tr>
<td>≥12 years</td>
<td>450 (18.9%)</td>
<td>452.9</td>
<td>687.6</td>
<td></td>
</tr>
</tbody>
</table>

## Study Site (village)

<table>
<thead>
<tr>
<th>Study Site</th>
<th>Baseline (N=2376)</th>
<th>Time in (person-years)</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>536 (22.6%)</td>
<td>1.7</td>
<td>1366.1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>447 (18.8%)</td>
<td>286.9</td>
<td>883.1</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>329 (13.9%)</td>
<td>329.0</td>
<td>518.3</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>414 (17.4%)</td>
<td>542.1</td>
<td>460.2</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>322 (13.6%)</td>
<td>337.0</td>
<td>358.3</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>322 (13.6%)</td>
<td>750.6</td>
<td>121.3</td>
<td></td>
</tr>
</tbody>
</table>

## BMI

- **Mean (SD)**
  - 27.2 (4.6)
- **Normal Weight**: 758 (32.7%)
- **Overweight**: 985 (42.5%)
- **Obese**: 573 (24.7%)

## Blood Pressure

- **SBP [mean (SD)]**: 113.1 (17.0)
- **DBP [mean (SD)]**: 72 (10.1)

## Hypertension

- **No**: 4614 (84.7%)
- **Yes**: 482 (18.3%)
Overall reductions in SBP and DBP

SBP -1.23 mm Hg [95% CI -0.38; -2.07], p = 0.004
DBP -0.72 mm Hg [95% CI -0.10; -1.34], p = 0.022
Reductions in SBP and DBP

People with hypertension
SBP -1.92 mm Hg [95% CI -3.29; -0.54]

Subjects ≥60 yo
SBP -2.17 mm Hg [95% CI -3.67; -0.68]
Cumulative probability of developing hypertension

Fully-adjusted model: HR 0.45 [95% CI 0.66 – 0.31], p<0.001
24-hour urine samples

Random sub-sample of 600 participants

**Sodium**
- Baseline: 3.94g ± SD 1.86
- End: 3.95g ± SD 1.83
  - p = 0.93

**Potassium**
- Baseline: 1.97g ± SD 1.20
- End: 2.60g ± SD
  - p < 0.001
Pragmatic intervention
Blood pressure matters

“Even a 2 mm Hg lower usual SBP would involve about 10% lower stroke mortality and about 7% lower mortality from IHD or other vascular causes in middle age.”

Conclusions

- Our project established an effective pragmatic population-wide salt substitute strategy
  - Reductions in the whole population’s blood pressure
  - Higher reductions in high-risk groups
    - Individuals with hypertension, ≥60 years old
  - 55% reduction in hypertension incidence (HR 0.45)
Key messages

• Hypertension rates and non-adherence to medication are global concerns, and non-pharmacological interventions at the population level to improve blood pressure control are required

• Our social marketing intervention demonstrated population-wide benefits
  – Public health gains through shifting the population distribution
  – Clinical and health systems impacts by halving hypertension incidence

• Switching to low-sodium high-potassium salts is feasible and it is effective in reducing blood pressure
The future

• Salt substitutes into daily life
  – Adaptation → further changes in Na, K
  – Think about K, not only about Na

• Potentially better results
  – 27% were 18-29 years-old
  – Baseline level of SBP was 113 mm Hg
Generosity
Innovation
Integrity
Quality

www.cronicas-upch.pe
Design: stepped wedge trial

Adverse events

None