Salt
From Evidence to Implementation

Graham A MacGregor
St. George’s Hospital
London
Major Underlying Factors causing Death - Worldwide

- Underweight
- Unsafe water, sani & hygiene
- Alcohol
- Physical inactivity
- High BMI
- Low fruit & vegetables intake
- Tobacco
- High cholesterol
- Unsafe sex
- Raised Blood Pressure
- Developed region
- Developing region

Atheroma in carotid artery

Plaque

Ulcerated Plaque

Fissured Plaque with Thrombosis
Major modifiable risk factors

- ↑ Blood pressure
- ↑ Total & LDL cholesterol, ↓ HDL
- Smoking
- Diabetes
- Lack of fruit and vegetables
- Lack of exercise
- Male pattern obesity

Unmodifiable

- Age
- Genetics
Systolic BP and Risk of Death

The risk starts at systolic 115 mmHg (83% adults)

MacMahon et al. Lancet 1990;335:765-74
South American Indians

On Evolutionary Diet
i.e. no salt, very little fat, no refined carbohydrate, fruits & vegetables ☑️, but aggressive fit, stress ☉☉

Male adults: Average BP: 96/61 mmHg
Average Cholesterol: 3.1 mmol/l
No rise in either with age
No vascular disease
What puts up population BP?

• Salt intake
• Lack of Fruit and vegetables
• Weight
• Lack of Exercise
• (Alcohol excess)
Salt

Until 5000 yrs ago 0.1 grams of salt per day
Now 10 to 12 grams per day

Why this big increase?
(a) Magical property of preserving food
(b) Cleans up tainted and/or unpalatable food

Deep freeze refrigerator
Therefore now no need

But still eating 10 to 12 gram per day courtesy of the food industry

80% (9.6 grams) of salt hidden in food

Only 15% (1.8 grams) added by consumer

Evidence

- **Epidemiology**
  - Over 50 population studies and Intersalt

- **Migration**
  - e.g. Kenya

- **Intervention**
  - Portuguese villages. New born babies

- **Genetic**
  - All defects identified so far impair the ability of the kidney to excrete salt

- **Mechanisms**
  - Plasma Na, corrected volume expansion

- **Animal**
  - All forms of hypertension are caused or aggravated by salt. Chimpanzees

- **Treatment**
  - Trials, Meta-analysis. Dose response

- **Mortality studies**
  - Finland (24h UNa)

- **Outcome trials**
  - TOHP, Taiwan (mineral salt: high K, low Na)
Population Study in Two Portuguese Villages (n=1600)

Blood pressure mmHg

Baseline | Year 1 | Year 2
---|---|---
Control | Intervention

50% difference in salt intake

* p<0.05, *** p<0.001 compared to Control Group

J Human Hypertens 1989;3:179
Genetic

Salt Aggravates

- G.R.A.
- 11β OH DEF
- 17α OH DEF
- A.M.E.

Salt Ameliorates

Mineralocorticoid Activity

↑

Kidney
Na+ Reabsorption

↓

Na Balance

BP

High BP

Low BP

Adapted. Cell 2001;104:545-556
<table>
<thead>
<tr>
<th>Salt Intake (g/day)</th>
<th>Systolic BP (mmHg)</th>
<th>Diastolic BP (mmHg)</th>
<th>Urinary Sodium (mmol/24h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>165</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>160</td>
<td>95</td>
<td>150</td>
</tr>
<tr>
<td>3</td>
<td>155</td>
<td>90</td>
<td>150</td>
</tr>
</tbody>
</table>

Randomised Double-Blind Crossover Study (N=20)


P<0.001 by repeated measures ANOVA.
DASH-Sodium Trial (All participants N=412)

<table>
<thead>
<tr>
<th>Salt intake (g/day)</th>
<th>8</th>
<th>6</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic BP (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinary Sodium (mmol/24h)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sacks et al. NEJM 2001; 344:3-10.
Dose Response: Meta-analysis (1 month or longer)

∴ A 6 g/day reduction in salt intake predicts a fall in SBP of:
↓ 7 mmHg in Hypertensives (p<0.001)
↓ 4 mmHg in Normotensives (p<0.01)

Avg. 5 mmHg

J Human Hypertens 2002;16:761
↓ salt intake 6g/day

↓ Stroke 24%

↓ CHD 18%

Worldwide 2.5 million (approx) Stroke & Heart attack deaths prevented / year

Feng J. He & GA. MacGregor Hypertension 2003;42:1093-99
Outcome trial
↓ 25% Salt intake → ↓ 25% CVD

Cumulative Incidence of CVD

TOHP I

Control
Salt reduction

TOHP II

Control
Salt reduction

Follow-up (years)

Cook et al. BMJ 2007;334:885
Salt - Other harmful effects

- Cancer of the stomach
  (↑ Salt (gastric irritant) - ↑ H pylori)
- Stroke
- LVH
- Heart failure. Idiopathic & cyclical oedema
- Kidney disease / Albuminuria
- Renal stones
- Bone demineralisation (osteoporosis)
  (↑ Salt - ↑ Urinary calcium)
- Asthma
- Menieres
Summary

Salt intake (10 – 12 g/day)
  • Population BP, rise in BP with age, hypertension
  • Other effects e.g. stomach cancer, stroke, LVH, kidney disease, osteoporosis etc

Reduce salt intake
  • from 10 - 12 g/day to 5 - 6g/day

(WHO target < 5g/day)
Salt Intake

1. Hidden salt
2. Added salt (Cooking, Table)
3. Salt
   a) Sauces/Spices, e.g. soya
   b) Dried products, e.g. salted fish

Strategy depends on major source of salt in each country
Hidden Salt – Its Commercial Value

- **SALT**
  - Producers (40% by value) → Profit
  - Food Industry
    - Dependence on salty taste (Salt Addiction)
      - Salt ↑
      - Demand for very salty foods ↑ → Profit
    - Highly Salted Processed Food (many = seawater)
      - 80% of intake
      - Meat products ↑ + Salt
        - Water Binding ↑
        - Weight ↑
          - No Cost
            - Profit
    - Salt ↑
      - Thirst ↑
      - Soft Drinks
        - Mineral Water ↑ → Profit
      - Profit

### Sea Water Comparison

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Sea Water Content</th>
<th>Alternative Food Item</th>
<th>Sea Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pizza</td>
<td>60%</td>
<td>Medium Sliced White</td>
<td>50%</td>
</tr>
<tr>
<td>Chicken Curry</td>
<td>60%</td>
<td>Granary Loaf</td>
<td>60%</td>
</tr>
<tr>
<td>Processed Cheese</td>
<td>130%</td>
<td>Crumpets</td>
<td>80%</td>
</tr>
<tr>
<td>Bacon</td>
<td>200%</td>
<td>Plain Scones</td>
<td>80%</td>
</tr>
<tr>
<td>Sausages</td>
<td>100%</td>
<td>Digestive</td>
<td>60%</td>
</tr>
<tr>
<td>Smoked Fish</td>
<td>190%</td>
<td>Cream Crackers</td>
<td>60%</td>
</tr>
<tr>
<td>Sweet Pickle</td>
<td>170%</td>
<td>Cheddar Cheese</td>
<td>70%</td>
</tr>
<tr>
<td>Lasagne</td>
<td>40%</td>
<td>Stilton Cheese</td>
<td>90%</td>
</tr>
<tr>
<td>Shepherds Pie</td>
<td>40%</td>
<td>Processed Cheese</td>
<td>130%</td>
</tr>
<tr>
<td>Frozen Prawns</td>
<td>80%</td>
<td>Branflakes</td>
<td>100%</td>
</tr>
<tr>
<td>Crisps</td>
<td>110%</td>
<td>Cornflakes</td>
<td>110%</td>
</tr>
<tr>
<td>Salad Cream</td>
<td>100%</td>
<td>Tomato Ketchup</td>
<td>110%</td>
</tr>
<tr>
<td>Savoury Biscuits</td>
<td>70%</td>
<td>Brown Sauce</td>
<td>100%</td>
</tr>
</tbody>
</table>
ACTIONS IN THE UK

Consensus Action on Salt & Health (CASH)

• Members all experts on salt and BP
• Set up 1996 in response to rejection of salt reduction recommendations by UK Dept. of Health

Aims

• Change Department of Health policy ✓
• Ensure Food Standards Agency adopted salt reduction & labeling ✓
• Media publicity to the public and food industry ✓
• Persuade retailers and food company’s to reduce salt added to food ✓

www.actiononsalt.org.uk
## UK Strategy for Reducing Salt

<table>
<thead>
<tr>
<th>Current salt intake / day</th>
<th>Reduction needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table / Cooking (15%)</strong></td>
<td>1.8 g, 50% reduction, 0.9 g</td>
</tr>
<tr>
<td><strong>Natural (5%)</strong></td>
<td>0.6 g, No reduction, 0.6 g</td>
</tr>
<tr>
<td><strong>Food industry (80%)</strong></td>
<td>9.6 g, 53% reduction, 4.5 g</td>
</tr>
</tbody>
</table>

**Total 12 g**

**Target 6 g**

- Food industry needs to reduce salt content of **ALL** foods where salt has been added by 53% over the next 5 years.

**UK salt intake**

- **2003** 9.5 g/day → **2006** 8.6 g/day
Killing them softly with salt

Strokes, heart attacks, high blood pressure. It's not good news, especially for the young who are consuming up to six times more than they should.

Hugh Davies reports
Food Standards Agency (UK)

- Set up to deal with BSE – New variant CJD
- What else? – salt reduction
  - Gradual reduction in salt added to foods 15%-25% by whole food industry
  - Repeated every 2 years
  - Aim: 2010 salt intake less than 6 g/d (adults)
  - 24h urinary sodium 2005, 9.0 g/24h compared to 2001 9.5 g/24h
I've always known it too much salt is bad for your heart.

Sid the slug

& Your brain & kidneys!
World Action on Salt & Health (WASH)

>300 members worldwide, >70 countries

**Target:** ↓ Salt intake worldwide to 5g/d (WHO)

**Worldwide**
- Globally Monitor and highlight foods high in salt
- Implement salt reduction plan worldwide
- Clear labeling system (traffic light)

**Individual Countries**
- Facilitate individual countries to set up expert groups on salt (similar to CASH) e.g. Canada, Australia
- Convince government and health dept. to adopt scientific evidence as in Finland, UK and ensure action by food industry
- Public health campaign to reduce salt consumption at home

http://www.worldactiononsalt.com
Croatia
How to reduce salt intake

- Set up CRoatian Action on Salt & Health (CRASH)?
  
a) Identify major sources of salt in diet
b) Campaign: Health Department
   Politicians
   Health professional
   Public campaign
   Food industry

c) Implement gradual reduction in salt added to food (10 to 20% per yr)
Summary

1. ↓Salt intake → ↓BP → ↓Stroke
   ↓Heart Attacks
   ↓Heart Failure
   ↓Stomach Cancer & Osteoporosis

2. ↓Salt intake → biggest improvement in public health since clean water and drains (19th Century)

www.actiononsalt.org.uk