

Science of Dietary Salt

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NO COMMERCIAL ASSOCIATIONS WITHIN 5 YEARS FOR NUTRITION

Paid Conflict of Interest

- Consultant to the Novartis Foundation regarding hypertension control in low to middle income settings

Unpaid academic activities

- Vice-Chair, Canadian Hypertension Advisory Committee
- Member, PAHO/WHO Technical Advisory Committee on dietary salt
- Member, WHO Nutrition Advisory Group
- Member, World Action on Salt and Health (WASH)
- Advisor to several governments on hypertension and dietary salt
- Executive member (Past President), World Hypertension League.

Sodium and salt

CONFUSING TERMINOLOGY !!!!

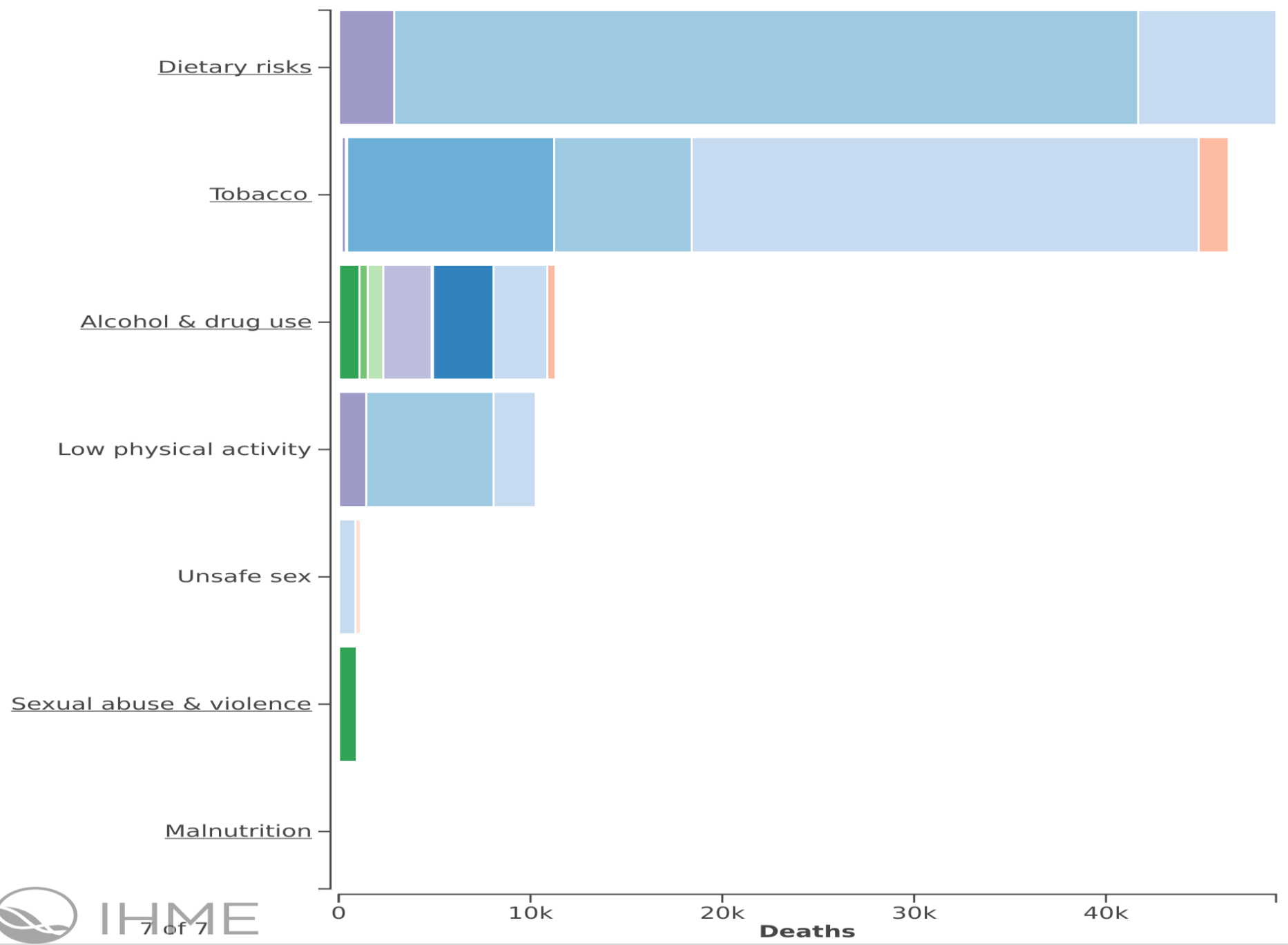
2300 mg (2.3 g) sodium (current UL) is about

- a teaspoon of salt (sodium chloride)
- 100 mmol of sodium or salt
- 5.8 gm (5800 mg) of salt (NaCl)

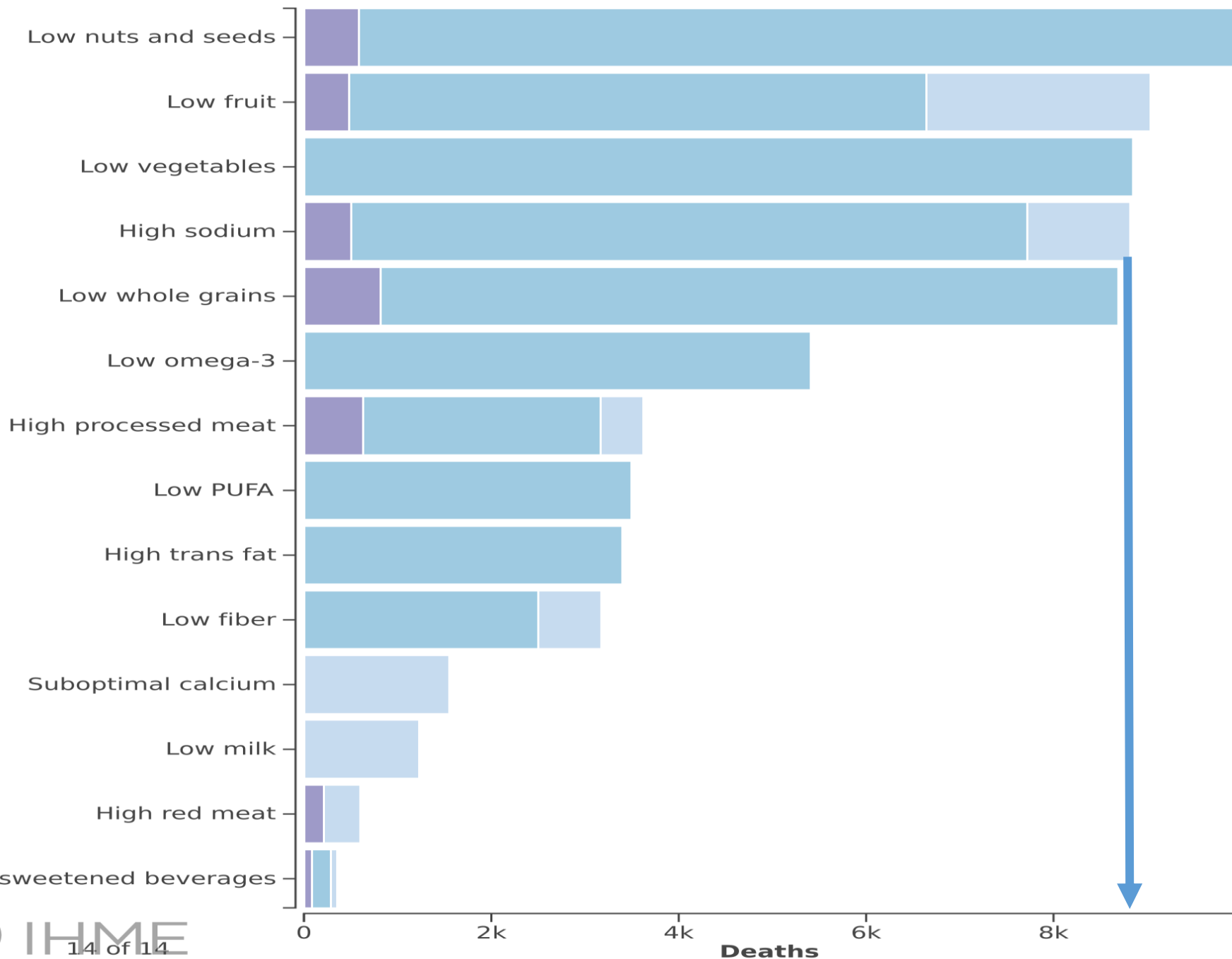
Disease burden from high dietary salt

- Global Burden of Disease Study estimated 4 million deaths, 80 million years of disability (DALYs) in 2015
- Up to a 32% reduction in prevalence of hypertension by reducing salt to recommended levels
- Globally about 500 million people are estimated to have hypertension caused by excess dietary salt.

Canada, Both sexes, All ages, 2015



Canada, Both sexes, All ages, 2015



Hypertension and Dietary Salt in Canada

- Hypertension is the 3rd leading risk for death and disability in Canada following dietary risks and tobacco use
- In 2013, an estimated 7.5 million Canadians had hypertension and in 2010 the health costs were estimated to be \$13.9 billion rising to \$20 billion in 2020.
- In Canada, about 2.4 million people living with hypertension caused by excess dietary salt.
- Excess dietary salt is a leading dietary risk in Canada
- In Canada, dietary salt is attributed to over 8,000 deaths and 130,000 DALYs in 2015.

Disease Burden

- The World Health Organization indicates dietary salt reduction to be one of a few most cost effective ways to improve population health
- 8.5 million deaths averted worldwide over 10 years by reducing salt intake 15%
- Slightly more cost effective than efforts to reduce tobacco use in low to middle income countries.
- In the USA cost savings of 10-30 billion dollars/yr and reduced CVD events by up to 260,000/yr, deaths up to 90,000/yr from reducing sodium by 1200 mg/day

Pathophysiology

There are 10,000's of studies spanning biomedical to population (~100 publications a week in medline), the vast majority support harm from sodium additives when quality indicators are applied

Pathophysiology of sodium

No animal species where salt induced htn is innocuous

INCREASED



↑ vascular volume with impaired vascular relaxation (a/h), sympathetic stimulation + central interactions with angiotensin II centrally (a)

INFLAMMATION
reactive oxygen species
reduced nitric oxide
stiffening endothelial cells
damaged glycocalyx (a)

Urinary calcium (a/h)
Markers of bone reabsorption (h)

Increased blood pressure (a/h)

Renal stones (h)
Osteoporosis (h)

Premature death and vascular disease (a/h)

Total cancer (h)
Gastric Cancer (a/h)
Renal cell cancer (h)
Asthma (a)
Adiposity (h)
Multiple sclerosis (h)
Rheumatoid arthritis (h)
Migraine (h)
Aortic aneurysm
Meniere's disease
Ovarian dysfunction

↑ LVH (a/h)
↑ renal impairment,
↑ glomerular pressure,
proteinuria (a/h)

Sodium and Blood pressure: Meta-analyses of RCT

Key features: random allocation; >920 mg/day reduction in sodium; assessed intake by 24 hr urine; >4 weeks duration; isolated intervention; 37 RCT in adults; 10 controlled trials in children not all that met inclusion criteria

Adults

Reduction of BP 3.14 (5.98 – 0.3) / 1.7 (3.1-0.33) mmHg;

Greater reduction in people with hypertension.

Greater reduction with sodium to less than 2000 mg/day vs >2000 mg/day.

Linear dose relationship to 1200 mg sodium/day.

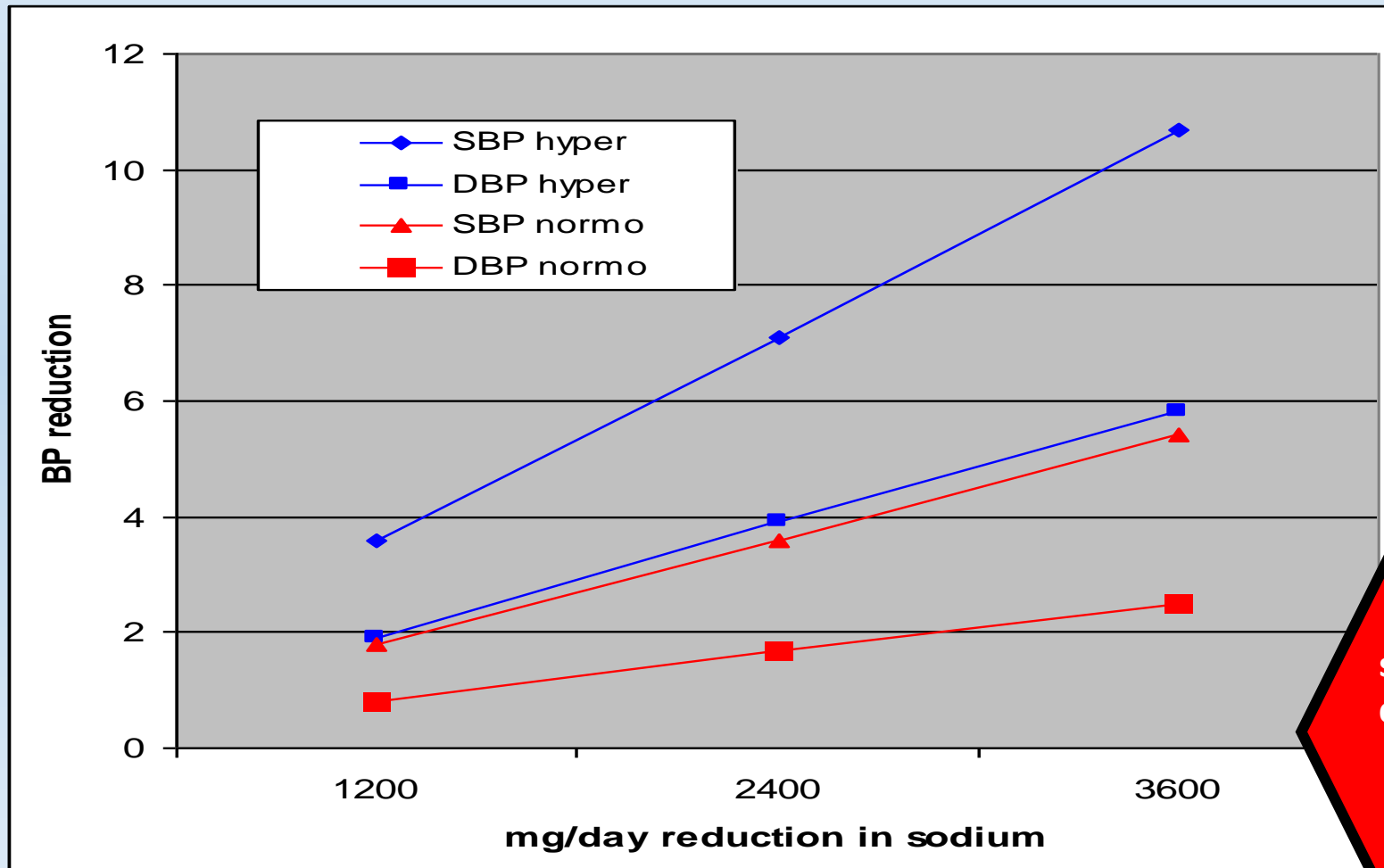
Less BP reduction than predicted in studies <4 weeks; predicted BP reductions >5 weeks

Children

Systolic Blood pressure decrease of 0.84/.87 mmHg

This data is the basis for predicted reduction in hypertension, CVD and health economics

Meta analysis on different levels of reduction in dietary sodium on blood pressure



This data shows a linear dose response of dietary sodium and BP reduction

Salt and CVD: Meta-analyses

- Cohort studies of CVD in non acutely ill healthy population; 1+ years duration
7-10 studies depending on outcome in question
- All cause mortality RR 1.06 (0.94-1.2)
- Stroke RR 1.24 (1.08-1.43)
- Fatal stroke RR 1.63 (1.27-2.1)
- Cardiovascular disease RR 1.12 (0.93-1.34)
- Coronary heart disease RR 1.04 (0.86-1.24)
- Fatal heart disease RR 1.32 (1.13-1.53)

This data shows associations of dietary sodium to CVD in healthy populations

Cochrane meta analysis of randomized controlled trials

All cause mortality lower dietary sodium

Normotensive **RR 0.67** (0.4-**1.1**)

Hypertensive **RR 1.0** (.86-**1.15**)

CVD death lower dietary sodium

Normotensive- no data

Hypertensive **RR 0.67** (0.45-**1.01**)

CVD events lower dietary sodium

Normotensive **RR 0.71** (0.42-**1.2**)

Hypertensive **RR 0.77** (0.57-**1.02**)

Combined RR 0.77 (0.63-0.95)

Range in sodium intake to 1500 mg/day



This meta analysis of controlled trials shows sodium increases CVD

Country experiences

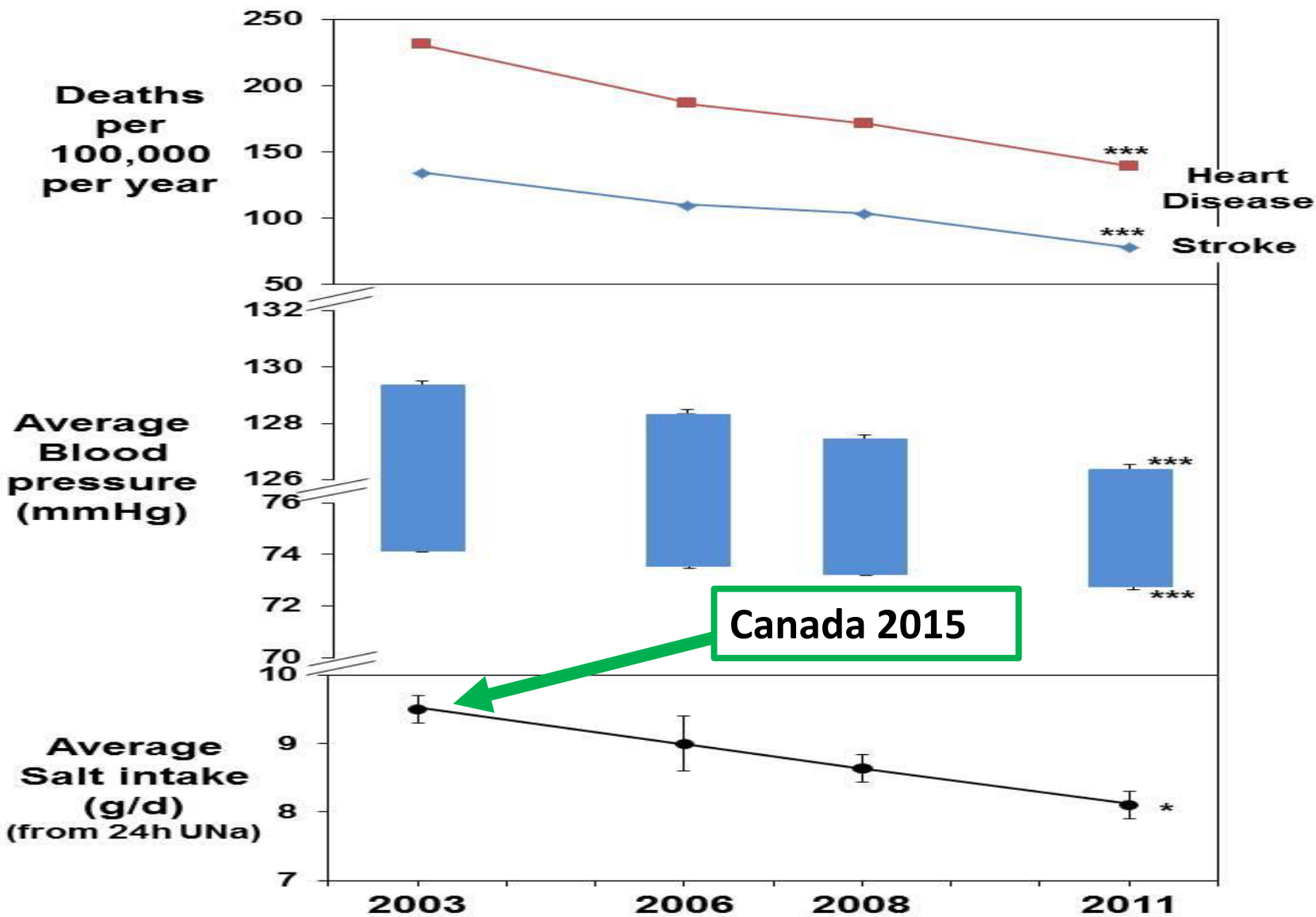
Established programs

- Finland, United Kingdom, Japan
- Salt reduction associated with lower blood pressure and lower cardiovascular event rates

Newer programs

- Korea: 2010-2014; 19% reduction (4831 to 3890 mg/day); htn 29% to 25.5% (2012-2014)
- Ireland: 2005-2012; 8% reduction (30% in children)

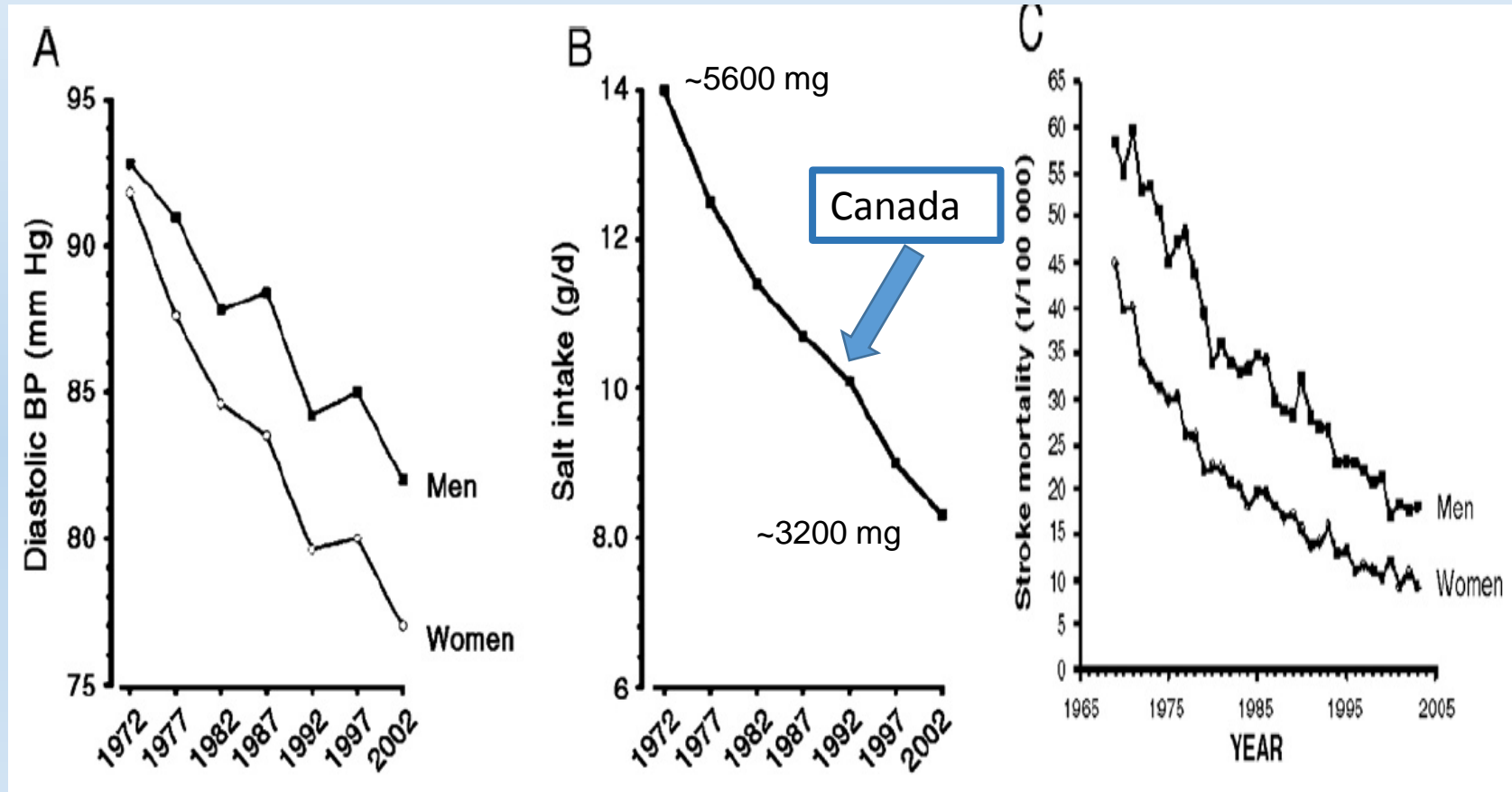
Changes in salt intake, blood pressure and CVD in the UK



Changes in salt intake, blood pressure and CVD in the UK

- **Average population sodium intake fell by 15%, from 3920 mg/day to 3240 mg/day ($P < 0.05$)**
- **Average population blood pressure fell by 3mm Hg systolic and 1.4mm Hg diastolic ($P < 0.001$)**
- **Stroke and heart disease deaths fell by approximately 40% ($P < 0.001$)**

Changes in BP, sodium and stroke in Finland



From Karppanen H et al Progress in Cardiovascular Disease 2006;49:59-75

Health and Scientific Organizations Dietary Sodium Recommendation

- World Health Organization
 - Health Canada
 - Heart and Stroke Foundation
 - Provinces/Territories/Federal government
 - Canadian Cardiovascular Society, Canadian Public Health Association/ Dietitians of Canada
 - Hypertension Canada
 - Institute of Medicine (RDI, 2014)
 - American Heart Association
 - UK government
 - 24 major Canadian Health and Scientific organizations
 - World Health Assembly
 - World Heart Federation
 - International Society of Nephrology
 - World Stroke Organization
 - International Society of Hypertension
 - World Hypertension league
- 1) Regulate reduced sodium in foods
 - 2) <2000 mg/day
 - 3) <2300 mg/day and aim for 1500 mg/day for adults
 - 4) <2300 mg/day
 - 5) Aim for 2000 mg/day
 - 6) Aim for 1500 mg/day and less in vulnerable
 - 7) <2400 mg/day
 - 8) 30% reduction

**There is no credible health or scientific organization
is against sodium reduction < 2400 mg/day and most
are \leq 2000 mg/day**

Scientific recommendations for the '2015 Dietary Guidelines for Americans' that followed a comprehensive systematic review of the literature

- A **healthy diet has little added room for sodium**, saturated fat and added sugars
- **Consume no more than 2300 mg sodium/day** and **further reduction in dietary sodium to 1500 mg/day can result in further reductions in blood pressure.**
- Although the reviewed evidence on associations between salt intake and direct health outcomes has methodological flaws and limitations, when considered collectively, it indicates a positive relationship between higher levels of intake and risk of CVD.
- **A reduction in dietary sodium by approximately 1000 mg/day reduces CVD by about 30%.**
- Data on potassium on BP and CVD is inconclusive.

Science of Sodium

- Science of Salt Weekly is an initiative of the (CIHR/HSFC) Chair in Hypertension Prevention and Control and the [George Institute for Global Health](#).
- This weekly newsletter features short summaries of relevant Medline-retrieved articles related to dietary sodium. To download issues or to sign-up for automated email updates, visit: <http://www.hypertensiointalk.com>
- Annual and now bimonthly critically appraised articles from systematic search in JCH also available free of charge.

ht - Science of Salt Weekly -
E-Newsletter

Issue 7 August 7, 2013

Science of Salt Weekly is a publication of weekly Medline searches related to dietary sodium. This is an initiative of the Canadian Institute for Health Research & Heart and Stroke Foundation Chair in Hypertension Prevention and Control. Funding has been provided by the Canadian Stroke Network and the George Institute for Global Health.

This initiative is supported by the following organizations:
[World Hypertension League \(WHL\)](#)
[World Health Organization \(WHO\) Collaborative Centre on Population Sodium Reduction](#)
[Pan American Health Organization \(PAHO\)](#)
[PAHO/WHO Technical Working Group on Cardiovascular Disease Prevention through Dietary Salt Reduction](#)
[World Action on Salt and Health \(WASH\)](#)

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SUMMARIES Continued

Category: Salt and Health Outcomes

Stolarz-Skrzypek K., Bednarski A., Czarnecka D. et al. Sodium and potassium and the pathogenesis of hypertension. [Review]. *Current Hypertension Reports*. 15(2):122-30, 2013 Apr.

A review was undertaken to examine the current available scientific evidence regarding the role of dietary salt and dietary potassium intake in the prevention and treatment of hypertension. The authors found that estimates from a meta-analysis of trials in normotensive subjects are generally similar to estimates derived from prospective population studies (+1.7-mmHg increase in systolic blood pressure per 100mmol change in the 24-hour urinary sodium excretion). However, this small increase in blood pressure does not translate into a higher risk of hypertension in subjects consuming a high-salt diet. The meta-analysis of intervention trials have consistently shown that potassium supplementation is associated with a decrease in blood pressure. However, prospective studies relating health outcomes to 24-hour urinary sodium and/or potassium excretion produced inconsistent results. Therefore, this review indicated that available evidence does not support the current recommendations of a

METHODOLOGY

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graph TD
    A[Total Medline articles  
N=70] --> B[Articles removed  
based on  
title abstract  
N=47]
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reviewed  
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as irrelevant  
N=7]
    C --> E[Articles included  
in synthesis  
N=16]
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First two years
of reviews with
quality filters-
no
controversial
studies

Low quality methods can produce J curves

- Reverse causality.
- Formula used in estimating 24 hr sodium from spot samples can generate a J curve.
- Complex control mechanisms for short term non steady state sodium excretion (spot samples) involve known vascular risk factors.
- A small number of researchers, many with 'potential' financial COIs, have generated many of the controversial research findings. Several of the studies were refuted but are still highly cited.

Conclusions

- **Extensive but incomplete evidence supports reducing dietary sodium**
- **Reducing dietary sodium is estimated to be one of the most effective and cost effective means to improve population health**