

# What are the potential health benefits from salt reduction. An overview

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# Salt intake

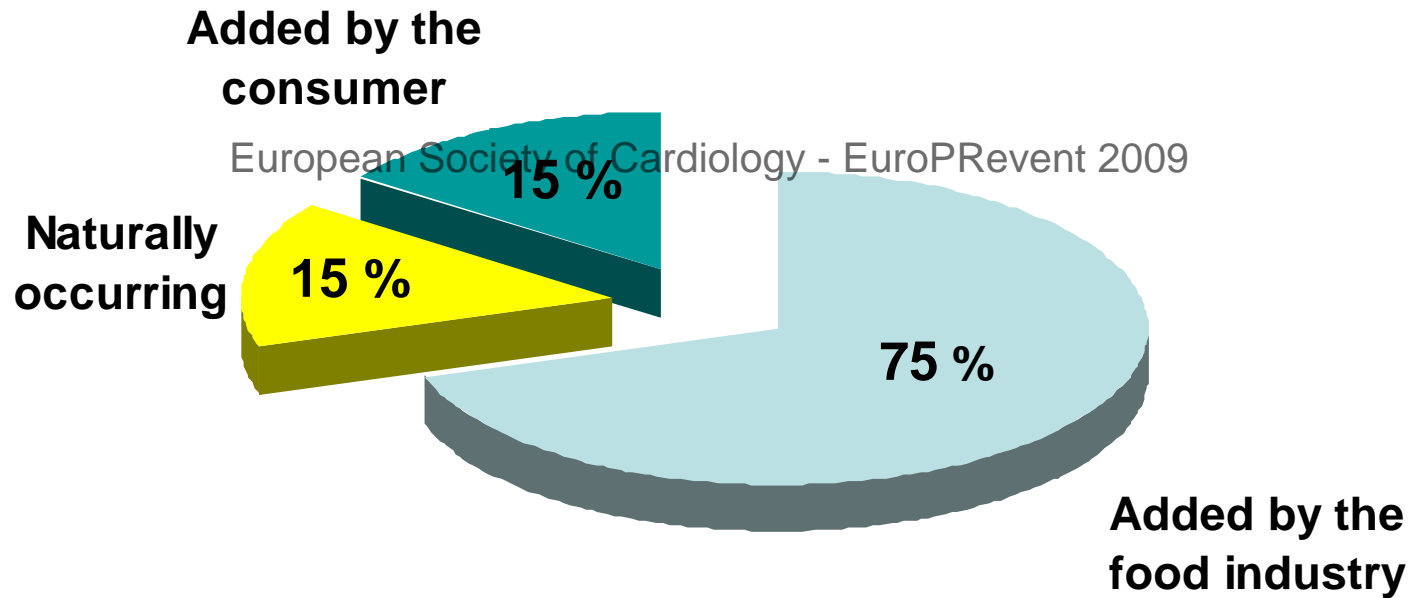
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# Typical salt intakes from different diets

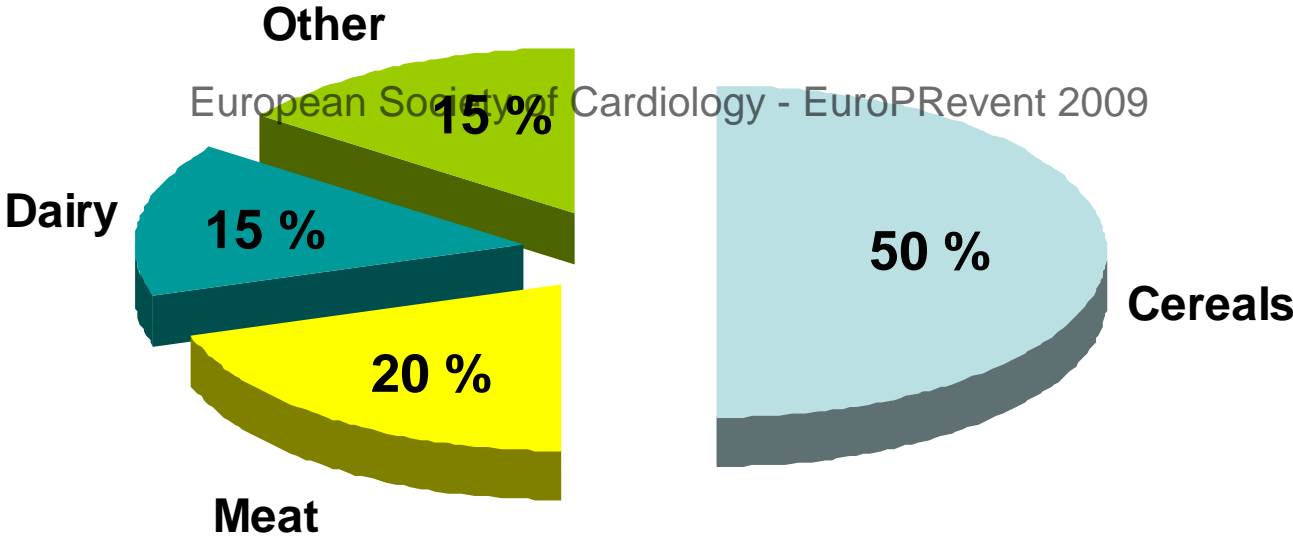
Western diet:	7-15	g salt/day	(~120-250	mmol Na/day)
Pre-agriculture diet:	1-3	g salt/day	(~20-50	mmol Na/day)
Recommended:	5-7	g salt/day	(~ 85-120	mmol Na/day)

Minimal requirement ~ 10 mmol Na/day (temperate climate, adapted)

# Contributors to the intake of salt



# Food contributors to salt intake



# Diseases associated with salt intake

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- **Hypertension and cardio-vascular disease**
- **Cancer (gastric)**
- **Diabetes type 2**
- **Osteoporosis**
- **Asthma**
- **Renal stones**

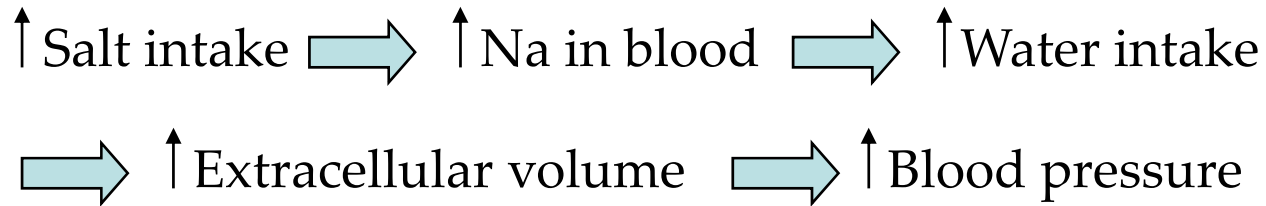
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# Hypertension and cardio-vascular disease

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# Pressure-natriuresis hypothesis

Geyton



## Reduced capacity to

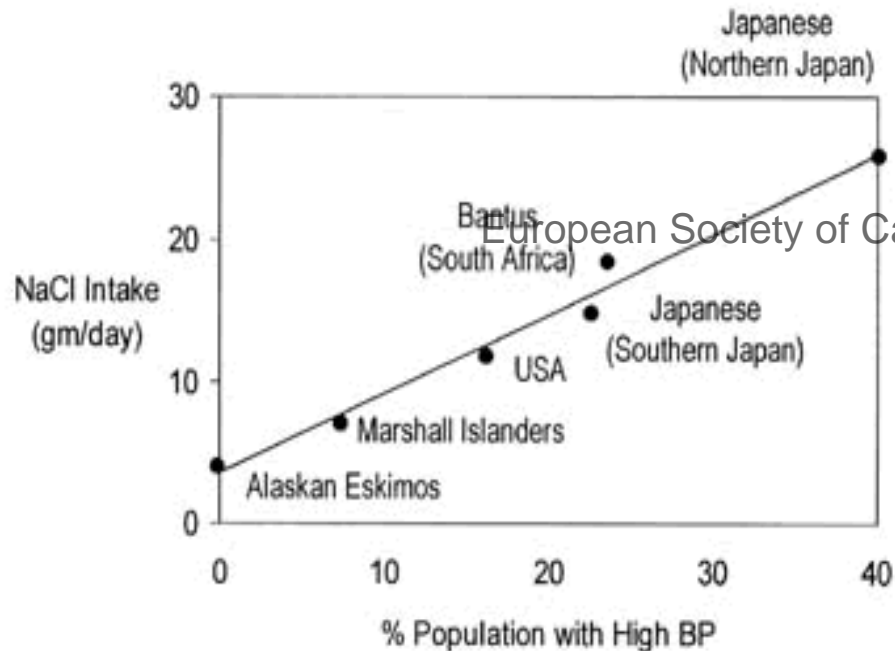
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↑ Excretion of sodium and water due to??

↑ Na-pump inhibitor  $\Rightarrow$  ↓ Na<sup>+</sup>/K<sup>+</sup>-ATPase activity

# Salt and blood pressure

## Epidemiological studies



Dahl 1960

**Between populations (with large variations in salt intake):**  
**Direct association between salt intake and blood pressure**

**With-in populations:**  
**No association between salt intake and blood pressure**

No association between salt intake and blood pressure level at population intake of ~10 g/day

## **Regression dilution**

Day-to-day variation in 24 hour Na excretion in the individual (intra-individual variation) is large and often larger than the variation from individual to individual (inter-individual variation).

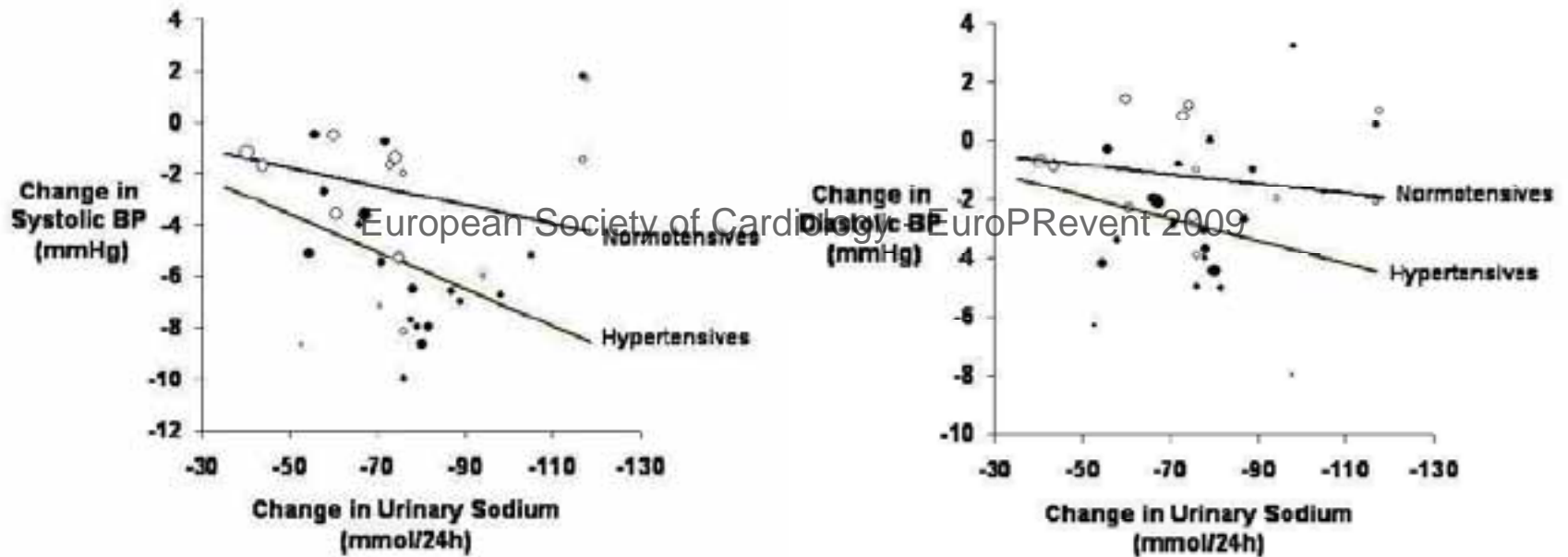
To estimate the true (within 2-10 %) habitual salt intake of an individual:

5-15 24 hour Na excretions [Liu og Stamler 1984; Liu et al. 1979; Luft et al. 1982; Siani et al. 1989]

30-60 diet records [Basiotis et al. 1987; Mattes and Donnelly 1991].

# Changes in blood pressure with changes in salt intake

Results from 31 randomized studies of >4 weeks' duration

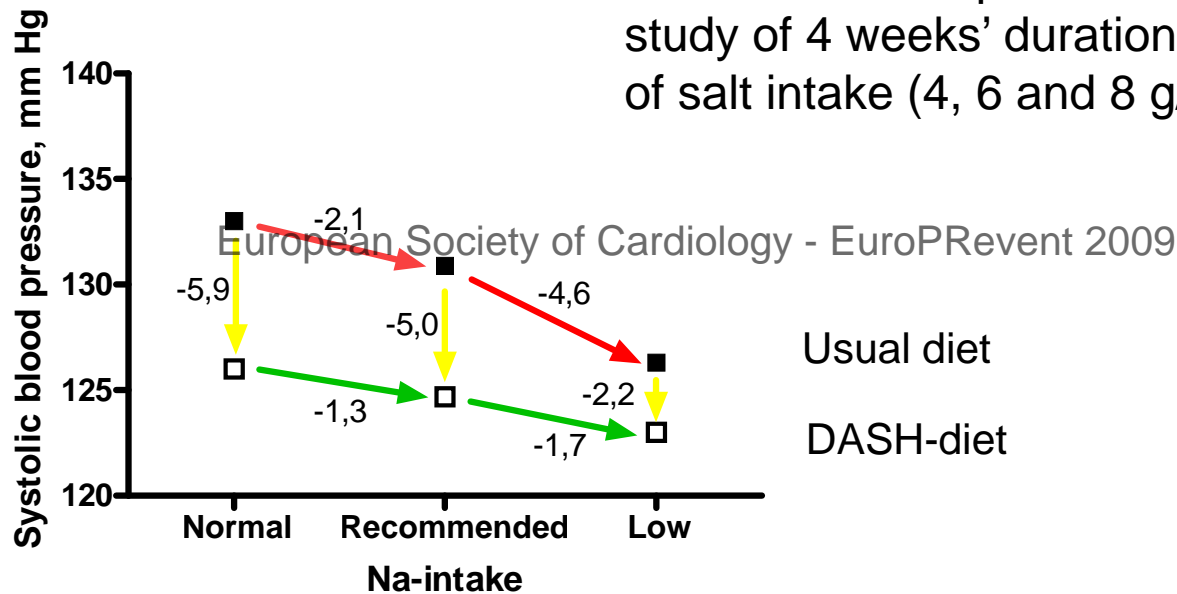


He and MacGregor 2004

# Dose-response association

## DASH-Sodium-trial

412 individuals with normal or moderately increased blood pressure. Randomized study of 4 weeks' duration on each level of salt intake (4, 6 and 8 g/day)



# Interventions at population level



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**Randomized intervention with controlled diets have demonstrated a blood pressure lowering effect of a reduced salt intake!**

**How about the effect on risk of cardiovascular disease?**

	<b>Salt reduction</b>		
	3 g/day	6 g/day	9 g/day
↓Systolic blood pressure (mm Hg)	2.5	5	7.5
↓Mortality from <i>stroke</i> (%)	12	23	32
↓Mortality from IHD (%)	9	16	23

He and MacGregor 2003; mortality data from Prospective Studies Collaboration 2002



# The association between intake of salt a risk of cardio-vascular disease

Prospective cohort studies

<b>Study</b>	<b>Results</b>
NY Worksite Study 1995	<b><u>Inverse</u></b> association with ischemic heart disease
Scottish Heart Health Study 1997	<b><u>No</u></b> association with ischemic heart disease
NHANES I Follow-up Study 1999	<b><u>No</u></b> association with ischemic heart disease. <b><u>Direct</u></b> association with stroke among obese; <b><u>No</u></b> association among normal weight subjects
Tuomilehto 2001	<b><u>Direct</u></b> association with ischemic heart disease. <b><u>No</u></b> association with stroke
Takayama Study 2004	<b><u>Direct</u></b> association with stroke among men. <b><u>No</u></b> association among women.
NHANES II Follow-up Study 2006	<b><u>Inverse</u></b> association with cardiovascular mortality
Japan Collaborative Cohort Study 2008	<b><u>Direct</u></b> association with stroke and cardiovascular mortality

# The association between intake of salt a risk of cardio-vascular disease

Randomized intervention study; Cook et al. 2007

## TOHP1 and TOHP2; Trials Of Hypertension Prevention

Subjects aged 30-54 years with diastolic blood pressure: 80-89 mm Hg

417 subjects randomized to salt restriction;

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Lifestyle intervention follow-up: 18-36 months ( $\downarrow$ Na excretion: 33-44 mmol/day)

Observational follow-up: 10-15 years

Cardio-vascular risk

Salt restriction vs. control: HR: 0.75; 0.57-0.99;  $P = 0.044$

**From a public health perspective:**

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**Should a lowered salt intake be targeted the whole population?  
Or are there specific risk groups?**

# Salt sensitivity/ resistance

Salt sensitivity/ resistance is not a stable characteristic (large intra-individual variation)

Salt sensitivity/ resistance is a continuous function with no clear delimitation

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Salt sensitivity occurs more often in hypertensives than in normotensives, especially in the

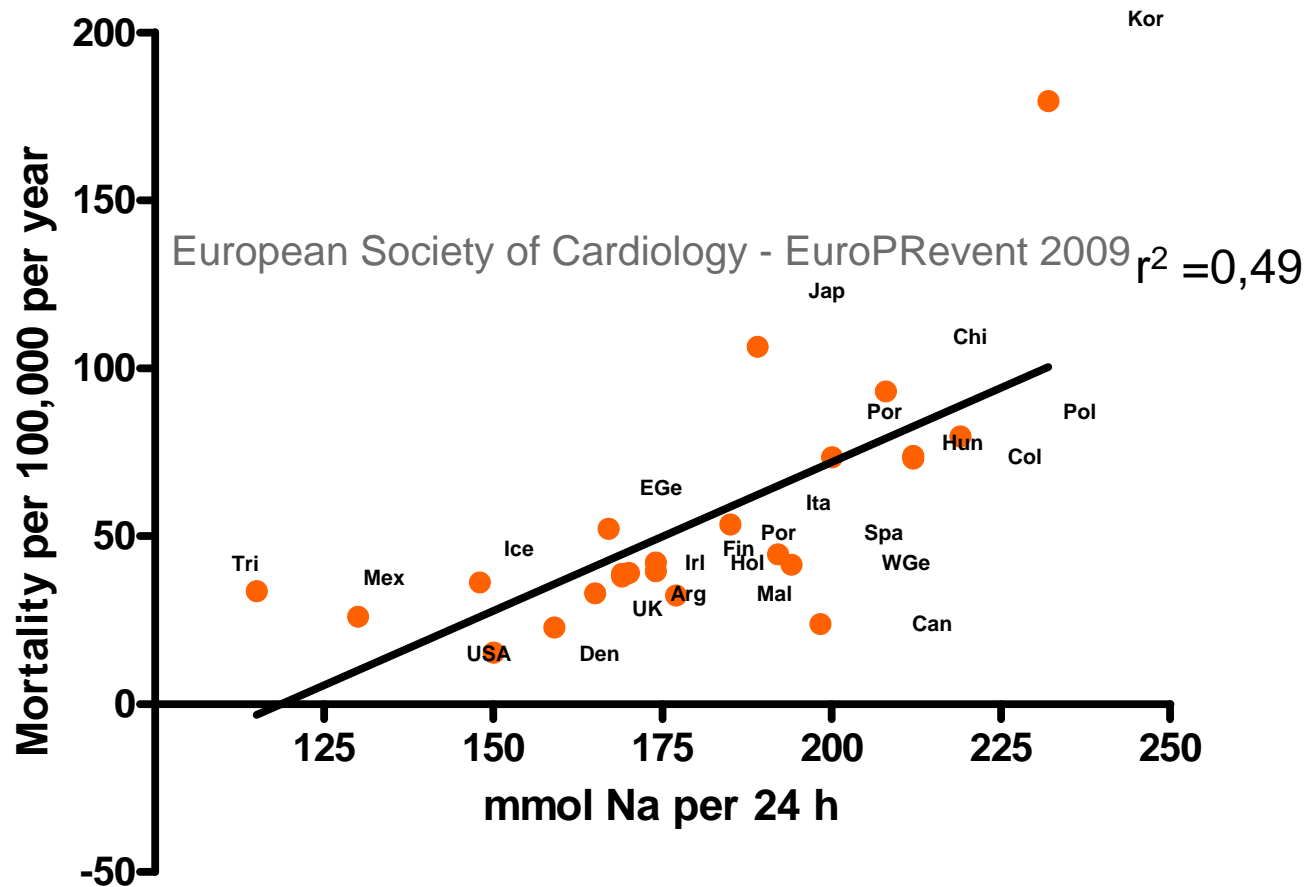
- Obese
- Insulin resistant
- Elderly

# Gastric cancer

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# The association between sodium intake and risk of gastric cancer (men)

Intersalt-study



# Salt and gastric cancer – pathogenetic mechanisms

## ↑ Salt intake

- Decreases the viscosity of gastric mucous → lowered protection against nitrosamines EuroPrevent 2009
- Has a direct toxic effect on the gastric mucosa → increased gastric cell proliferation and risk of mutations
- Increases the proliferation of Helicobacter Pylori in the gastric mucosa

# The association between the intake of salt and gastric cancer

Prospective cohort studies

Study	Results
Netherland's Cohort Study 2003	<u>No</u> association with the intake of salt. <u>Inverse</u> association with the use of salt for the hot meal.
Japan Public Health Center Study 2004	<u>Direct</u> association with the intake of salt in men but not in women. <u>Direct</u> association with the intake of salty foods in both sexes.
Hisayama Study 2006	<u>Direct</u> association with the intake of salt over 10 g/day augmented if H. pylori infection and atrophic gastritis
Nord-Trondelag County Study 2008	<u>No</u> association with the intake of salt

# Other diseases

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# Salt intake and other diseases

## **Osteoporosis and fracture**

↑Salt intake increases urinary calcium loss

No prospective studies in humans

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## **Diabetes mellitus**

↑Salt intake increases insulin resistance

1 prospective study has shown increased risk of diabetes

Type 2 with increased salt intake [Hu et al. 2005]

# Salt intake and other diseases

## **Asthma**

↑Salt intake increases contractility of smooth muscle cells  
A Cochrane-analysis (6 randomized studies) no effect on lung function or asthma symptoms [Ramog Ardern 2004]

## **Renal stones**

↑Salt intake increases urinary calcium excretion  
1 prospective study has shown increased risk of renal stones with increased salt intake [Curhan et al. 1997]

# Conclusions

- **Dose-dependent reductions in blood pressure with reduced salt intake in randomized studies**
- **A halving of the usual salt intake will lower systolic blood pressure with 5 mm Hg and diastolic blood pressure with 2.5 mm Hg, more so in hypertensives than in normotensives**
- **Insufficient evidence (mainly from cohort studies) for an effect on cardio-vascular disease of reduced salt intake**
- **Salt is only 1 among several dietary factors with an effect on blood pressure**
- **Insufficient evidence for an effect on other diseases**

# Thank you for your attention

